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FEBRUARY 14, 1946

Editorial Index, Page 41

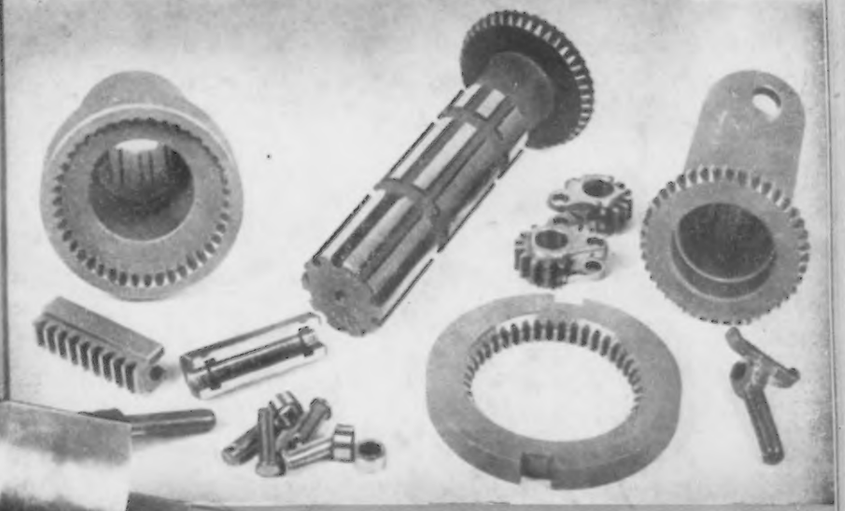
FEB 14 1946

THE IRON AGE

Practical Uses for HOLDEN Carburizing Baths

WRITE FOR HOLDEN CARBURIZING BULLETIN I.G. 104

Intricate Parts Carburized in Hard Case 400 at 1550°F.



Production Tools Carburized to .001 to .120 in.

Tool Steels above 0.70 Carbon Hardened without Carburization or Decarburization.

Write For Bulletin I.G. 104

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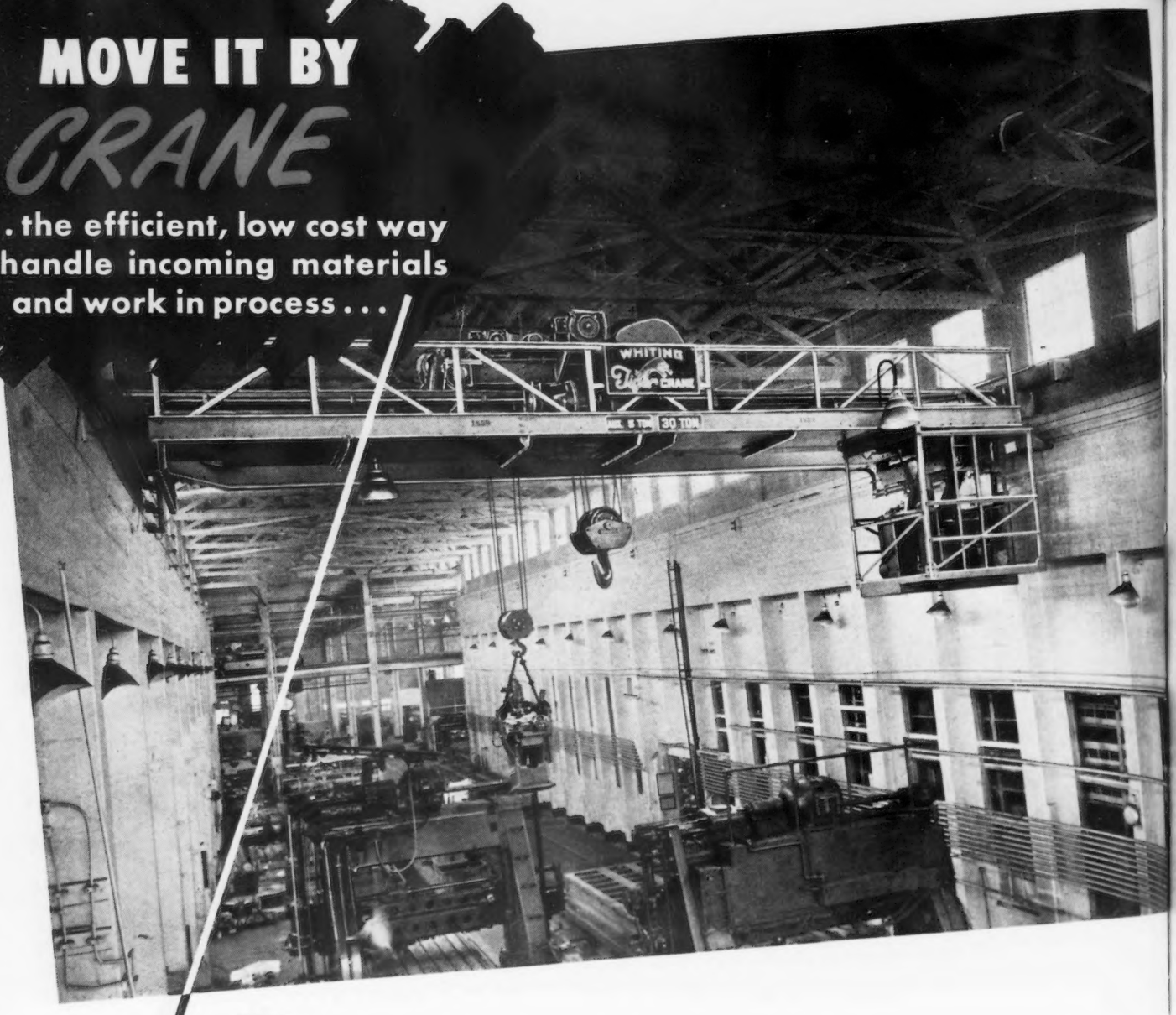

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IRON AGE

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Training and Trainers

PREPARING to talk to the men who train new employees in the automotive industry, at a meeting this week in Detroit, I thought it would be a good idea to see what the dictionary had to say about a "trainer." The dictionary, by the way, sometimes yields rather surprising results to those who have the courage to open its covers.

I found that one of the oldest definitions of a trainer, and I hope now obsolete, was "One who romps, cuts up or carries on."

That at least would indicate that trainers are human and therefore likable, but I imagine that the alternative definition: "One who educates another to perform a task" is more applicable in this instance.

Going back to my own experience in industry, which covers more years than most people care to admit, I recall that trainers were unknown and unsung. In those days, the introduction was through apprenticeship. When you completed the first year at 7½¢ per hr, and finally in four years made the grade and a mechanic's pay of 15¢ per hr, you knew you had arrived.

After you went through such an apprenticeship, you could run a lathe, milling machine or a dozen other machine tools and perform sundry assembly operations, including scraping bearings to the queen's taste. In other words, given the blueprints of a 14-cylinder modern radial airplane engine and the material, you were equipped to machine and put together every part of it and then give it the final test.

That was "all around" training. With it a mechanic could single handed take on the building of such a mechanism but it would have taken him the rest of his life to complete the more than 80,000 operations involved in it.

That sort of procedure was too slow for a product-hungry American public with money to spend. So we developed mass production. And mass production means the splitting up of operations into their least common denominators, plus a means of conveying skill to accomplish them in four to six weeks instead of four years.

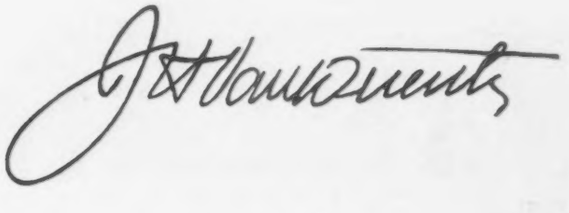
That is the way that training came into the picture. Not to romp, to cut up or to carry on, but to educate.

So today, industrial training has become a great and recognized profession. Its function is to impart skill. Specialized skill.

But I think that it has an even more important function. After all, first impressions are generally the strongest and most lasting. And in a large organization, the trainer introduces the company to the new employee and vice-versa.

That is quite a responsibility. And it means that the trainer should be equipped not alone with the skill that he is to impart but also with a substantial grounding in his company employee relations policies.

If that was the accepted practice in industry, the terrifically high turnover rate of the first few months of employment could be materially reduced.



HOW TO DEVELOP LOWER DELIVERED COSTS OF STEEL

Here Is a Cost Factor Worth Checking

Steel is a low cost large tonnage product when compared with other metals. But the net cost delivered alongside your machinery and equipment varies greatly in different plants depending upon the mill methods of packing and shipping — and the manufacturers' methods of receiving and handling.

Inland metallurgists control quality from the ore to the finished product . . . but the preservation of that quality is still another factor in final machine side delivery.

So Inland shipping experts prepare the steel with care and pack it for safe arrival and quick economical receiving and handling.

But there are so many types of equipment that may be used in receiving and handling that it is important that the shipping and receiving methods dovetail in order to secure the lowest possible costs. To develop this teamwork between us, it is often advisable to compare notes.

Inland shippers are available to consult with you at any time and make recommendations toward the lowering of your final machine side cost of steel.

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INLAND STEEL

The IRON AGE
Feb. 12, 1946

NEWSFRONT

► Magnesium producers are basing their market planning on a new high speed molding machine now in its final developmental stages which is expected to bring the cost of mass produced magnesium castings below permanent mold production cost.

Also under development is a new type of permanent mold technique in which the pot is inverted and becomes the riser.

► A well known producer of aircraft exhaust manifolds is said to have diversified its postwar production to the extent of making stainless steel caskets, photographic equipment, midget racing cars and precision castings.

► A light weight, low-powered, low cost car of standard size called the Bobbi-Kar is in experimental production in San Diego. Rear mounted engine and drive assembly are said to be replaceable in ten minutes.

► Submarine construction has not been dropped by the United States since the end of the war. Contracts for two submarines, previously terminated, have recently been reinstated bringing up to eight the year's program of the builder.

► Large volumes of diversified parts can be cleaned, Bonderized, sprayed and baked in a conveyorized enameling unit designed by I-T-E Circuit Breaker Co. from a combination of standard units. Specially designed parts can be closely controlled to maintain required quality and hold rejects below 0.5 pct.

Flexibility is gained through controlled conveyor speed and oven temperature. Stampings, ferrous and non-ferrous castings, and molded plastic parts can be handled. Parts that do not require Bonderizing are short circuited during that period.

► Flash buttwelding has been extended to the low alloy steels and, after heat treatment, properties can be developed in welds that approximate the unwelded material.

Experience with flash buttwelds of direct hardening nickel alloy steels as A8640 and SAE 3140 shows that with proper adjustment of the electrical setup, sound welds free from defects can be made.

► For gas welding the presence of nickel in steel rods has been found beneficial since it improves flow characteristics and cuts down sparking. With a commercial rod containing 0.15 pct max C and 1.25 pct nickel all deposited metal having a minimum tensile strength of 62,000 psi and elongation in 2 in. of 22 pct was obtained in the as-welded condition.

► Outstanding advantage of oxyacetylene pressure welding is its ability to make welds with high joint efficiency in the field far removed from shop facilities.

Percentage of alloys present in the low-alloy steels exert little influence on the quality of pressure welds.

► New impetus to the use of salt baths for production heat treatment has been the development of the submerged water-cooled electrode salt bath. This design, which utilizes a ceramic pot with sealed-in submerged water-cooled electrodes, gives uniformity of temperature because all the heat is generated at the bottom of the pot by passing current from the electrodes directly through the salt.

Nitrate salt baths may be used to color bright steel parts, the color varying with the temperature employed. At 450°F, the bath imparts a light straw color while at 575°F a bright blue hue is obtained.

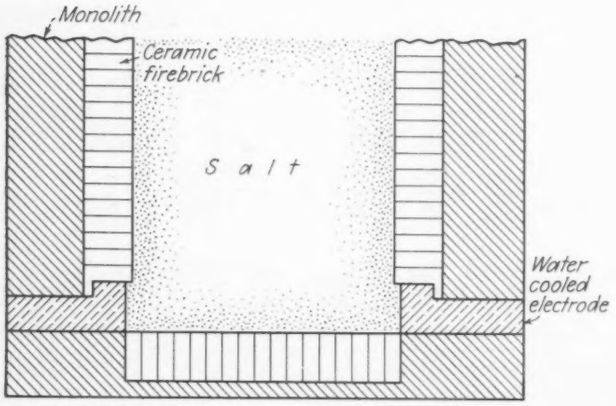
► Shortages of welding engineers and trained personnel proved a serious handicap to the production of welded products in Germany. This lack of welding engineers was probably the most serious handicap but despite the urgent need the rigid standard of qualifications was lowered only slightly. In addition there was an increasing lack of welding equipment, accessories and electrodes.

That problem was partially settled by widespread use of multiple panel welders and automatic welding machines. A spotwelder with a rating of 600 spots per min was used advantageously. However, automatic welding machines never reached popularity in Germany.

Characteristics and Uses Of

SALT BATHS

THE generally accepted definition for salt baths is, "baths composed of one or more salts, designed to form a heating medium inert to the work, and which may be intended to either carburize, decarburize, nitride, or otherwise affect the surface of the work." Work heated in salt baths is generally free from scale, and the thin film of molten salt that always adheres to the work, prevents contact with the atmosphere and its subsequent alteration of surface chemistry, and can be effectively removed.



• • Fig. 1—Sketch of a submerged-electrode furnace.

The vast production during the war years has greatly enhanced the use of salt baths for production heat treating. This adoption of the salt-bath method of heating has been due to its flexibility, ease of installing into a production line, and economy of operation, but most of all, the wide acceptance is due to improved methods of heating. Possibly the most revolutionary type of furnace is the submerged electrode type, fig. 1, which utilizes a ceramic pot with sealed-in submerged water-cooled electrodes, and generates heat by passing current from these electrodes directly through the salt. In this design, because the heat is all generated at the bottom of the pot, great uniformity of temperature is attained. If heat were applied from the top or elsewhere, very slow, erratic heating would most certainly result.

This submerged-electrode design makes possible the construction of deep furnaces of small cross-section, furnaces 9 ft deep by 8 in. square being quite practical. In this design the submerged water-cooled electrodes, protected from contact between their hot surfaces and the atmosphere, do not errode nor oxidize at a rapid rate as do immersed electrodes employed in other designs; neither does the electrical resistance of the electrodes vary with operating temperature.

Regardless of the type of heating used, salt baths lend themselves readily to mechanization. Such mechanical contrivances can follow the merry-go-round type of mechanical unit in which the handling fixture is mounted in the center of a circle, with two or more salt baths located radially around it. When in operation, work is advanced from bath to bath by elevating and rotating the fixture, permitting the work to be advanced and immersed progressively in the various baths to effect the desired heat treatment. Screw conveyors are often used where a motor-driven worm located over or alongside the furnace pot automatically moves suspended work through the molten salt at a selected rate. Jack-rabbit systems are also used where work is automatically "jumped" from bath to bath, being moved by screw conveyor while traversing any single unit. By adaptions of any of the above methods or combinations of same, a great number of effects can be derived, limited only by the ingenuity of the design engineers.

Usually mechanization, see fig. 2, of a heat treating operation by installation of a salt bath and suitable conveyors has reduced labor costs and invariably produced more uniform results. In one small tool plant a conversion from muffle-type atmosphere-control furnaces to salt baths tripled the productivity of the heat-treating department, with no increased labor cost.

For other articles on the use of salt bath see THE IRON AGE, *April* 26, 1945, *Jan.* 18, 1945, *June* 24 1943 *and April* 3, 1941.

The wartime developed NE steels have been particularly suitable for salt-bath treatments, since their narrow hardening ranges require close control of time and temperature during hardening. Salt baths further provide the ideal medium for hot-quenching as indicated by the T-T-T curves and embraces such practices as isothermal quenching, austempering, martempering, and interrupted quenching. Definitely proven superior for many heat-treated parts, isothermal treatments such as austempering have provided greater safety to shock parts, greater toughness at a given hardness, less distortion, and overall improved physical properties from a given analysis, than can be obtained by the older quench and temper methods.

Wartime high-speed steels containing molybdenum,

Development of the submerged water-cooled electrode salt-bath design has given new impetus to the use of salt baths in production heat treatment of both ferrous and nonferrous metals and alloys. This and other improvements in heat treating; carburizing and nitriding baths are reviewed by the author as well as chemical compositions and physical properties of the solutions used.

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By R. C. STEWART

Apco Industries Limited, Leaside (Toronto), Canada.

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generally a headache when treated by other methods, have proven a natural for salt-bath treatments. In fact, nearly all the large makers of small tools are now using the salt-bath method entirely for the hardening of high-speed-steel tools.

Stainless steels are now annealed at 2000°F and simultaneously descaled in molten caustic baths.

Large baths have been installed and used for the solution heat treatment of the duralumin alloys in the aircraft industry.

Neutral Salt Baths

Chloride-Carbonate Salts are generally eutectic mixtures of potassium chloride and sodium carbonate. Physical properties are as follows:

Melting point	= 1070° F
Weight solid	= 140 lb per cu ft
Weight 1400°	= 110 lb per cu ft
Specific heat	= 0.23 (solid)
Specific heat	= 0.34 (liquid)
Latent ht of fusion	= 106 Btu per lb

This type of salt is generally used at temperatures from 1200° to 1600°F max, in pressed or fabricated steel pots, preferably calorized. It should never be used in ceramic pots, since the alkali carbonate will attack the ceramic.

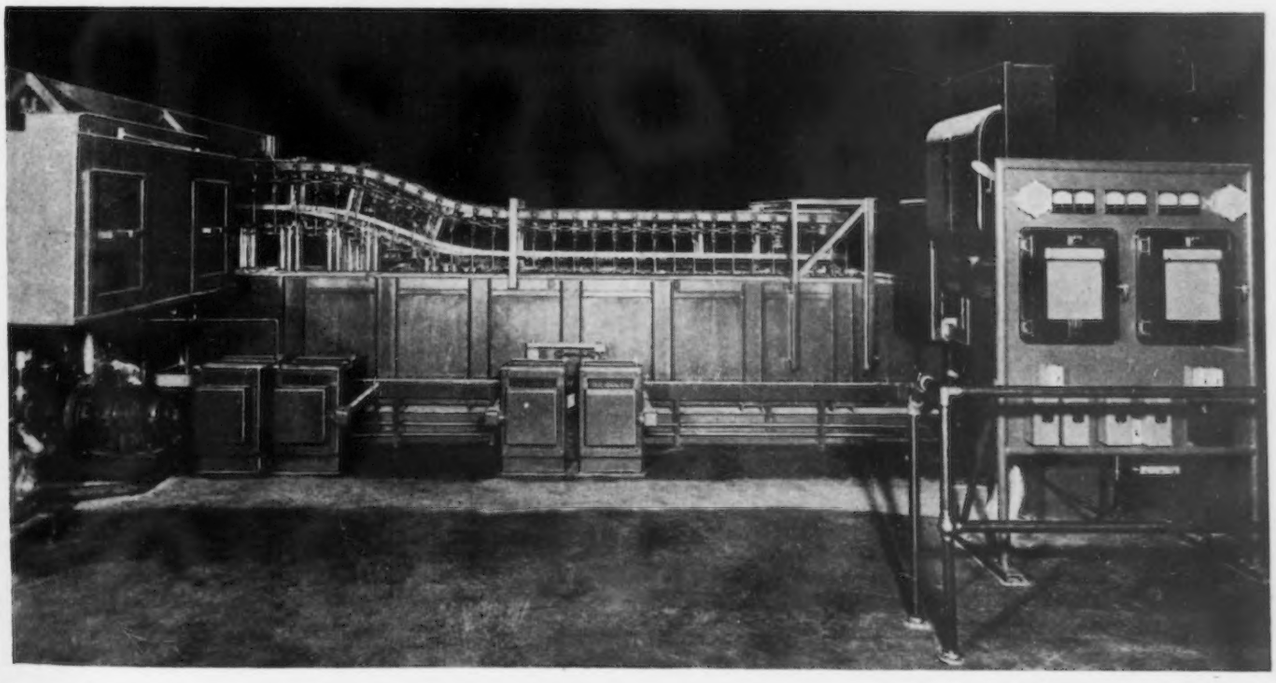
The salt is decarburizing to all but the low-carbon steels. It decarburizes tool steels quite readily, although it is often used for their heat treatment, especially where grinding is necessary, or if the heating cycle is short. This type can be rendered nondecarburizing by the addition of ½ pct by weight of sodium cyanide every 4 hr of operation. It will not dissolve iron oxide from the work or the pot, and work quenched from such a salt will have a dark colored surface.

Double Chloride Salts are generally eutectic mixtures of sodium and potassium chloride. Physical properties are as follows:

Melting point	= 1220° F
Weight solid	= 130 lb per cu ft
Weight 1600°	= 118 lb per cu ft
Specific heat	= 0.20 (solid)
Specific heat	= 0.26 (liquid)
Latent ht of fusion	= 183 Btu per lb

This salt can be used from 1300° to 1650°F without fuming. It can be contained in either a steel,

• • Fig. 2—A mechanized salt bath.



alloy or ceramic pot. The salt is nondecarburizing when free from oxides and can be used for the treatment of all steels without decarburization when properly deoxidized, or rectified. If not rectified at regular intervals, the salt will rapidly erode metallic pots at the salt-air interface. It is well known that chloride salts dissolve metallic oxides readily, as exemplified by the use of zinc and ammonium chlorides as flux for soldering, and the use of chlorides in welding fluxes. At the salt-air interface iron oxide will occur on the pot metal, which would normally retard further oxidation, particularly on an alloy pot. With double chloride salts this oxide is dissolved by the molten salt leaving a bare metallic surface. The bare metallic surface is again oxidized by atmospheric attack, and also by the oxides now in solution in the bath. Once again the chlorides will exert their solvent action on this new oxide, dissolve it, and the cycle is repeated until the pot fails. Daily rectification of the bath with either ferrosilicon or silicon carbide will prevent this corrosive attack upon metallic pots, by keeping the salt free from oxides in solution.

Another source of trouble with double chloride baths, is decarburization after some hours of operation, due to the formation of alkali oxides within the bath. This condition can be detected by dissolving a sample of the salt in distilled water, and determining alkalinity (when dissolved in water the oxides become hydroxides which are alkaline in reaction). This condition can be controlled by the rectification of the bath daily with boric acid. Modern double-chloride baths, however, prevent this type of decarburization by the addition of 2 pct of barium chloride to the mixture. This addition will prevent the accumulation of any Na_2O or K_2O, any oxygen pickup being converted finally into $BaCO_3$, which is nondecarizing. Like the chloride-carbonate baths the double chloride baths may be rendered nondecarburizing by the addition of ½ pct of sodium carbonate every 4 hr of operation. Shortly after such additions, the oxides observed floating in the bath should be removed.

Ternary Chloride Baths—Generally eutectic mixtures of the chlorides of sodium, potassium and barium. These salts have the following physical properties:

Melting point	= 1020° F
Weight solid	= 192 lb per cu ft
Weight 1400°	= 145 lb per cu ft
Specific heat	= 0.14 (solid)
Specific heat	= 0.18 (liquid)
Latent ht of fusion	= 95 Btu per lb

The working range of this type is from 1100° to 1800°F and it is generally used in either alloy or ceramic pots, due to its higher operating temperatures. This type is nondecarburizing, and noncorrosive if deoxidized with ferrosilicon or silicon carbide, and can be operated to higher temperatures if a carbon float is added to stop radiation and fuming. At the higher temperatures it can also be rectified with a carbon rod.

High Speed Salts

High Speed High Heat Salt—For the high-temperature treatment of high-speed steels barium chloride is generally used. This salt has a melting point of 1760°F and a density of 241 lb per cu ft.

It is recommended for use in ceramic-lined high-speed furnaces only, and is most successful if used in submerged-electrode furnaces. Freedom from oxide contamination at the salt-air electrode interface (submerged electrodes introduce no oxide into the bath) renders very little rectification necessary, all sources of oxide contamination being extraneous from rusty work, fixtures, etc. In the immersed electrode type of furnace cyclic errosion such as described under the double chloride baths proceeds at an accelerated rate, with failure of the electrodes occurring at 2340°F in as little as 14 days. Immersed-electrode furnaces require daily rectification with either ferrosilicon or silicon carbide, while submerged-electrode furnaces can be controlled by the simple introduction of a graphite rod into the molten salt, which will reduce any oxides into metal, whereupon they will adhere to and can be readily removed with, the rod (this is similar to the deoxidation of molten copper by poling it with a green stick).

The nodules adhering to the carbon rod were examined and found to be lederburite, the iron-iron carbide eutectic. While the graphite rod is in use, bubbles (CO_2) are seen to rise from it and break at the bath surface with no flame. As deoxidation is completed these bubbles change to CO, which is easily recognized by the characteristic flames that appear when the bubbles burst at the surface.

High Speed Preheat Salt—These are generally ternary chloride baths similar to those already described.

High Speed Quench Salts—This may be either the same salt that is used for the preheat bath, to which has been added from 5 to 20 pct of sodium cyanide, or it may be one of the following compositions:

(1)	Sodium cyanide	= 30.0 pct
	Potassium chloride	= 20.0 pct
	Barium carbonate	= 10.0 pct
	Sodium carbonate	= 40.0 pct
	or	
(2)	Sodium cyanide	= 55.0 pct
	Potassium chloride	= 25.0 pct
	Sodium carbonate	= 20.0 pct

Sodium cyanide present in quench baths will carburize effectively during the quench, and will nitride the high-speed steels to a depth of 0.002 to 0.003 in.; during the short period at which the steel is at an exceedingly high temperature during the cooling cycle. This gives the steel an exceptionally hard, abrasion-resisting surface. Care must be taken to remove traces of any cyanide salts from fixtures prior to their return through the high-heat and preheat baths, as any alkalinity built up in these neutral baths will cause decarburization.

In general, in all neutral or chloride baths, calcium salts are not recommended, even though they provide very low melting-point compositions, as they are difficult to remove with the usual alkali cleaners and are very corrosive in nature to the metal parts being treated.

Tempering Salts are nitrate-nitrate salts composed of a eutectic mixture of sodium nitrite, and potassium nitrate. The physical properties are listed as follows:

Melting point	= 280° F
Weight solid	= 133 lb per cu ft
Weight at 600° F	= 116 lb per cu ft
Specific heat	= 0.32 (solid)
Specific heat	= 0.37 (liquid)
Latent ht of fusion	= 35 Btu per lb

This is the standard low-temperature salt and has a range of from 300° to 1100°F.

It is generally considered safe to only 1000°F in pressed or fabricated steel pots, but can be readily operated to 1100°F in a calorized or alloy pot. It is well to operate baths over a metal or ceramic catch basin, since a bath temperature greater than 1100°F may cause pot failure. These low-melting salts can be successfully used in a ceramic furnace, although the average outside temperature of the ceramic bath must be below the melting point of the salt, otherwise the salt will seep out. For this reason encasing ceramic pots in metal is not good practice, as it impairs natural radiation from the surface, and may permit molten salt to seep through, whereas if the outside is below the melting point, no salt can run out.

All organic matter should be kept out of a low-temperature bath, since it will react explosively, and will also contaminate the bath with dirt and carbonate sludge. In any event, cyanide in any form should not be allowed to come near or into such a molten mixture. Presence of nitrates in these mixtures provides good rust and corrosion inhibition, and much longer pot life can be obtained than in straight nitrate baths commonly used for the duralumin alloys. For any such operation it is advisable to insist on the presence of nitrates in the salt mixtures.

430 Melting salt—This sodium—potassium nitrate eutectic has the following properties:

Melting point	= 430° F
Weight solid	= 142 lb per cu ft
Weight 800° F	= 118 lb per cu ft
Specific heat	= 0.32 (solid)
Specific heat	= 0.36 (liquid)
Latent ht of fusion	= 63 Btu per lb

The general properties of this salt mixture are similar to the "275" type, but it is considerably more corrosive. It can be operated up to maximum temperature of 1150°F in suitable calorized, alloy or ceramic pots. Both this salt and the nitrite-nitrate eutectic can be used for coloring or blackening steel parts, either molten at temperatures of 500 to 900°F, or at temperatures of about 280 to 290°F in caustic soda-water solution.

Cyanide Salts

Case Hardening—Various methods of increasing the surface hardness of steel parts may be collectively termed case hardening. Molten case-hardening baths all derive their action from their cyanide content which may, under suitable conditions, supply carbon and nitrogen to the surface of the parts, greatly increasing surface hardness especially in the presence of nitrogen. These nitrogen-containing parts also exhibit exceptional wear resistance. The nitrogen pickup is obtained to a large degree only in baths of straight cyanide. Addition agents can be used to increase carbon and lower nitrogen pickup, so that thus by suitable selection, pickup can be varied from traces of nitrogen to a total nitride case.

Chemistry—Sodium cyanide itself does not produce any case, sodium cyanate being the active carburizing ingredient. The cyanate is formed by surface reaction between the bath and the oxygen of the air,

$$2\,NaCN + O_2 = 2\,NaCNO$$

At operating temperatures this breaks down as follows:

$$4\,NaCNO = Na_2CO_3 + 2NaCN + CO + N_2$$

The carbon monoxide and nitrogen combine by direct action of the nascent nitrogen, and further dissociation of the carbon monoxide,

$$2CO = CO_2 + C$$

The carbon dioxide liberated reacts with more cyanide so that,

$$NaCN + CO_2 = NaCNO + CO$$

The rate of formation of cyanate and the rate at which the free carbon is liberated at the metal surface, determines the case-hardening activity of the bath.

Carburizing Baths

Sodium cyanide either used alone, diluted with sodium chloride, and/or sodium carbonate will behave as described above, as a shallow casing medium. In order to provide deep cases at a rapid rate, two basic faults must be overcome:

(1) In cyanide-treated work the nitrogen absorption at the surface produces a dense nitride layer relatively impervious to carbon penetration. In ammonia-gas nitriding, the nitride layer can be removed by immersing the parts in a molten chloride bath and holding at 1600° F for a time. If such suitable chlorides are added to a cyanide bath, the nitrogen layer will be either destroyed, or prevented from forming to any great extent, and carburization will then progress as long as the temperature is maintained.

(2) In pack carburizing it has long been known that alkaline earth carbonates are the best accelerators or catalysts for production of rapid deep carbon cases. Therefore, it is natural that these materials be tried as accelerators for liquid carburizing. They have proved very successful and are today a necessary ingredient in all successful carburizing salts. Composition of typical salts vary as follows:

Sodium Cyanide, Pct	Alkali and Alkaline-Earth Chlorides, Pct	Alkali and Alkaline-Earth Carbonates, Pct
40.0	60.0	....
40.0	30.0	30.0
60.0	40.0	....
60.0	15.0	25.0

The final choice of alkali and alkaline-earth combination will depend upon whether water solubility is desired, since the mixtures containing alkaline earth salts present greater cleaning problems, due to initial insolubility or formation of insolubles when cleaned in alkaline metal cleaners.

Baths of the accelerated type may, if they contain alkaline earths, be operated at temperatures as high as 1750°F in suitable pots. At the higher temperatures carburization is speeded up by the absence of nitrogen as well as by the higher temperature, until it is as rapid as gas, or pack carburizing. In other words, with the effective elimination of the nitrogen problem, the absorption rate of the steel is the determining factor, not the salt composition, and this absorption rate is a function of steel analysis and

operating temperature. To operate efficiently at these higher temperatures, the baths should be protected by a floating graphite cover, which cuts down radiation (saving fuel or electricity) and prolongs the pot life. This type of bath is not dependent upon a high cyanate content, so protection from the atmosphere will not impair its action, but will actually effect an economy, by preventing oxidation of the cyanide content. Table I illustrates the effect of varying atmosphere composition on rates of carburization.

Nitriding Baths

On suitable steels such as Nitralloy, high-speed, and high-carbon high-chrome, nitriding similar to that obtained with dissociated ammonia can be obtained by immersing the parts in a suitable molten cyanide mixture at 900° to 1100°F to produce a case at the rate of 0.001 in. per hr. Suitable baths may be either eutectic mixtures of sodium and potassium cyanides, or cheaper mixtures of 55 pct sodium cyanide, 25 pct potasssium chloride, and 20 pct sodium carbonate. The former salt melts at about 850°F, while the latter melts at about 910°F when new.

Salt-Bath Operation

Chloride-Carbonate Neutral Baths are generally used in small externally-fired pots. Usually no care is required and no rectification necessary when heating low and medium-alloy steels of SAE grades and low and medium-carbon steels, or when annealing or hardening copper, brass, nickel, monel and silver. Work to be hardened should be quenched in a 5-pct brine, or better still, cyanide solution to brighten the surface. If a reducing condition is desired in this type of salt bath it may be obtained by adding 1 to 2 pct sodium cyanide. This addition will produce bright metallic surfaces on the work, and will reduce further the corrosive action of the salt on the pot. Springs and parts subject to vibrating stress should not be treated in a bath containing cyanide, as the superficial nitride case produced will cause surface cracking and subsequent failure.

Double-Chloride Baths used in internally or externally heated pots, for high-carbon and tool steels, must be rectified regularly for truly neutral operation. This rectification should consist of adding 0.25 pct of a mixture of ferrosilicon and boric acid for each 8 hr of operation (preferably at the end of a shift). After the rectifier has been allowed to react for at least ½ hr, the temperature should be allowed to drop somewhat, and any top or bottom sludge removed (the sludge has the appearance of cupola slag). An alternate method is to add 1 to 2 pct sodium cyanide to produce a reducing condition.

It is strongly recommended, that when breaking in a new pot, to run it idle for 24 to 48 hr at about 1500°F with a 2 to 3 pct addition of sodium cyanide in the salt. After this period it may be burned out and rectification started with ferrosilicon and boric acid. This treatment is particularly advantageous if the pot has any porous areas. These areas generally contain oxides which are easily dissolved out by the chloride salts. Cyanide treatment reduces this oxide to metal and then carburizes it, producing a volume increase which "tamps the voids shut," decreasing porosity of the spongy areas.

Triple-Chloride Baths—This type of salt is used to a maximum working temperature of 1850°F, and requires less rectification than the double-chloride type. Metallic oxides are the main source of trouble, but are easily removed by rectification with ferrosilicon-boric acid deoxidizers, or with silicon carbide. Use of sodium cyanide is not recommended with this type of mixture, as it will cause sludging. In any event, sodium cyanide and boric-acid type deoxidizers should not be used simultaneously, due to formation of a viscous, difficult to remove, boron glass. If operated in a ceramic pot, no cyanide should be added under any circumstance. At temperatures of 1700°F and above, more efficient operation is obtained by the use of a graphite cover, which at the higher temperatures has a reducing and cleaning action on the bath. Graphite is not recommended as a float on immersed electrode neutral baths.

High-Speed Baths—Are successful only in ceramic furnaces and are especially economical if the submerged-electrode type is used. They must be rectified daily with silicon carbide, or ferrosilicon-boric acid type deoxidizers, whereupon oxides are removed as silicate slags. If alkalinity appears, it may be controlled by the addition of silica flour at intervals. A float of sil-o-cel is sometimes used to reduce radiation. Graphite must never be used as a float, as the rate of carburization is extremely rapid on any metal parts such as tools or electrodes, at temperatures in the vicinity of 2300°F.

Tempering Baths—These baths need no maintenance other than periodic additions to compensate for dragout. Work entering these baths should first be thoroughly degreased, since any oil or other organic matter is consumed by the bath, forming carbonates which will sludge out as concentration increases.

Isothermal Baths—These are also nitrate-nitrite baths, and may be operated at from 300° to 800°F to produce the properties desired. If it is desired to quench from a carburizing bath into an isothermal bath it is necessary to keep the sodium cyanide content below 10 pct, and preferably about 5 pct. At these low cyanide contents no trouble is experienced from explosions or other violent reactions. The quench bath will gradually become contaminated with chloride or carbonate salt, however, and at the most popular operating temperature, 550°F, up to 20 pct of these impurities will go into solution. They can be removed by cooling the bath to near its freezing point, and ladling out the sludge. Great care must be taken to keep nitrate contamination out of neutral baths by thoroughly washing all fixtures prior to use. Traces of nitrates in neutral baths will cause decarburization and pitting.

Coloring Baths—Bright steel parts may be colored in molten nitrate baths, the color varying with temperature as indicated below.

Time = 5 min	
Colorless	= 425° F
Light straw	= 450° F
Straw	= 475° F
Brown	= 500° F
Purple	= 525° F
Purple-blue	= 550° F
Bright blue	= 575° F
Gunmetal	= 625° F

Blackening Baths—These baths are usually mixtures of nitrate salts and sodium hydroxide, and may

be used molten at from 500 to 800°F, with from 5 to 10 min immersion. Upon removal from the bath the work is washed to remove adhering salt, and coated with oil to brighten the finish and to render the parts more corrosion resistant. If parts will not tolerate the high temperature necessary, they can be treated in a concentrated aqueous solution of the above mixture, with the concentration adjusted to produce constant boiling at about 290 to 300°F.

Carburizing Baths

In externally-fired metallic pots, a large selection of carburizing salts are available to accomplish the desired results, such as good water solubility, stability, etc. The rate of penetration however, is largely if not entirely a function of the analysis of the steel and the operating temperature, increasing as operating temperature is raised. Minimum temperature at which rapid action is initiated is however influenced by salt composition. The alkali cyanide types produce effective cases on suitable (nickel) steels at temperatures as low as 1450°F. Alkaline earth salts do not become very active until well over 1550°F.

Ceramic Carburizing Baths—A distant innovation has been the successful operation of ceramic baths. This method is possible only in submerged-electrode types of ceramic lined furnaces, and is subject to two conditions: (1) The ceramic material must be very basic; magnesite refractories, such as are used for the hearth of a forging furnace, are ideal for this purpose. (2) The carburizing salt must be so balanced that under operating conditions no alkali carbonates can be formed.

If the second condition is satisfied, it is noted that deep cases can be obtained with as low as 3 pct cyanide in the bath. If any alkali carbonates are present, an excess of cyanide, about 12 to 18 pct, must be added to counter the decarburizing action of the carbonates. In operating ceramic carburizing baths therefore, little cyanide is required, and four-fifths of the makeup additions can be of a simple neutral-chloride material, in addition to the carburizing salt. The economy thus effected is obvious. Such baths have been operated in Canada for a period of over two years without any shutdowns due to ceramic failure.

Shutdowns versus Idling—The use of ceramic salt baths arouses a great deal of discussion pro and con regarding shutdowns. Actually such baths, when properly designed, can be shut down and restarted with very little trouble; however it is actually more economical in many instances to idle such furnaces rather than to allow them to freeze. There are two reasons for this: (1) Many shutdowns occur overnight, or during weekends when off-peak power is available at very low cost, and (2) molten salt requires very little heat to keep it molten, but relatively a great deal of heat to melt it, i.e., all salt-bath materials have a very low specific heat, and a very high latent heat of fusion. As a typical example, to idle a 40 kva high-speed furnace, it is put directly on a low input hold tap provided in the transformer, the thermocouple removed, and the furnace left continuously connected. The tap will supply about 10 kva, and no matter how long it is left connected, it will hold the salt at about 1750°, fully molten around the electrodes, permitting quick return to operating temperature when desired. To remelt would require considerable time with full furnace input. Regardless of the fact that modern ceramic furnaces are sturdy it is always better for the furnace if shutdowns are avoided, eliminating thermal shock.

TABLE I

Carburizing Rates of Various Steels

SAE 1020 at 1600° F (2 hr)			SAE 1020 at 1750° F (2 hr)		
Depth, In.	C, Pct	N_2, Pct	Depth, In.	C, Pct	N_2, Pct
0.004	0.74	0.32	0.004	0.86	0.08
0.008	0.72	0.04	0.008	0.96	0.07
0.012	0.60	0.03	0.012	0.91	0.06
0.016	0.45	0.02	0.016	0.84	0.04
0.020	0.36	0.01	0.020	0.71	0.03
0.024	0.27	0.01	0.024	0.60	0.02
0.028	0.22		0.028	0.48	
0.032	0.20	Nil	0.032	0.40	Nil
			0.036	0.35	Nil
			0.040	0.31	Nil
			0.044	0.29	Nil
			0.048	0.26	Nil
			0.052	0.24	Nil
			0.056	0.23	Nil

SAE 3312 at 1700° F (2 hr)			SAE 4615 at 1700° F (2 hr)		
Depth In.	C, Pct	N_2, Pct	Depth, In.	C, Pct	N_2, Pct
0.004	0.82	0.18	0.004	0.71	0.18
0.008	0.83	0.02	0.008	0.83	0.06
0.012	0.70	0.01	0.012	0.70	0.05
0.016	0.54	0.01	0.016	0.56	0.04
0.020	0.46		0.020	0.48	0.02
0.024	0.37	Nil	0.024	0.42	0.01
0.028	0.24	Nil	0.028	0.37	Nil
0.032	0.19	Nil	0.032	0.33	Nil
0.036	0.16	Nil	0.036	0.26	Nil
			0.040	0.22	Nil

Pots

Fabricated or pressed-steel pots are ideal for tempering baths, and also for low-temperature heat-treating baths for intermittent operation. Calorizing inside and out will greatly extend the service life. Steel pots also give good service life with cyanide salts or those containing carbonates.

The double and triple-chloride salts are generally considered extremely corrosive to steel pots, and even to the alloy pots. Actual mechanism of this attack is subject of much controversy, but the damage is generally detected only on the outside of the pot. This observation, and information gained from metallographic examination, indicates grain boundary attack forming chromates on the outside of the pot which due to their low melting points slough off readily and expose new metal to the attack of the combustion gases. For the double chlorides nickel-chrome pots high in nickel are used; the 60 nickel-12 chrome and the 35 nickel-12 chrome are most commonly used.

For ternary-chloride mixtures which contain barium, straight 28-pct chromium iron with the minimum amount of nickel necessary to maintain good foundry practice, should be used.

Great care must always be taken to prevent access of salt into the combustion chamber, particularly if the mixture contains barium, since barium tends to form barium chromate, a compound with a very low melting point which is fluxed off the outside of the pot by the combustion gases, exposing new metal to continued attack. In any event all pots to be used with neutral salts should when new be started with

a small cyanide addition to the mixture. This cyanide will eliminate the oxides from the inner pot surface and effectively prevent inside chloride attack.

Fuel-fired pots should be turned in their settings at regular intervals, to prevent damage by burner-flame impingement.

Pyrometer guard tubes should be made from inconel for carburizing salt baths and of nickel for the neutral baths.

When shutting down a salt bath, a large wedge should be inserted near the axis of the pot, and the salt allowed to freeze around it. When restarting the bath this wedge is removed; the void acts as a well in which the melting salt can flow, thus eliminating trouble with spurting.

Disposal—In general, salt-bath residues are so low in cyanide content that they offer no disposal problem, since the usual discard in the plant or community dump permits the action of rain and atmosphere to rapidly dissipate any cyanide in the residue. Contrary to popular opinion, the fumes given off from a cyanide bath, working at very high temperatures, are nonpoisonous, consisting of nothing but sodium carbonate. Although nonpoisonous, it is very irritating to the mucous membranes, and in contact with moist skin it produces irritation due to its alkalinity.

Salt Bath Analysis

Cyanide and Carburiizng Baths—Normally, the only determinations of vital interest are cyanide content, alkali carbonate content, and possibly chloride content.

Suitable samples can be obtained by quickly plunging a dry cold rod into the molten bath, and immediately removing it. The thin film of salt that adheres to the rod, spalls off readily as it cools.

Preparation of Sample—A 4.901 sample of the salt is dissolved in 500 cc of distilled water. If the bath has been used, and sulfur is present, about 200 cc of the above solution is shaken with 1 to 2 g of lead carbonate, precipitating black lead sulfide.

Cyanide Determination—The solution is filtered through a dry filter paper, and 50 cc taken for the cyanide determination. In a small flask add to the sample a small amount (0.25 cc of a 10 pct sol.) of potassium iodide, and titrate with N/10 silver nitrate (vigorously agitating the solution) until a faint permanent turbidity is produced. This end point is best seen by looking through the solution against a black background.

Calculation: cc N/10 $AgNO_3$ used $\times$ 2 = Pct sodium cyanide.

Carbonate Determination—To 50 cc of the filtered solution which has not been treated with the lead carbonate, add 0.5 cc in excess of the amount of silver nitrate used for the cyanide determination. Then add 50 cc of a 10 pct solution of barium chloride, shake, cork tightly and allow to settle for 2 hr or longer. The precipitation is filtered and washed with water containing barium chloride (1 pct) (the filtrate can be reserved for sodium hydroxide determination). Place the filter paper containing the $BaCO_3$ in a beaker, and add a few drops of methyl orange indicator solution, 100 cc of distilled water, and an excess of N/10 hydrochloric acid. Warm to expel CO_2 and after cooling, titrate the excess with N/10 sodium hydroxide.

Calculation: cc N/10 HCl $\times$ 1.0814 = Pct sodium carbonate.

Hydroxide Determination—The filtrate and washings from the carbonate determination are titrated with N/10 HCl, using phenolphthalein as indicator.

Calculation: cc N/10 HCl $\times$ 0.8161 = Pct NaOH

Sodium Chloride Determination—A 50 cc aliquot is titrated with silver nitrate, using potassium dichromate as indicator, until a permanent red color is produced.

Calculation:

$$\frac{\text{cc}AgNO^3 - (\text{cyanide titration} \times 2) - 5846}{0.4901} = \text{Pct sodium chloride}$$

Alkalinity in Neutral Baths—A 1-g sample of the salt is dissolved in 100 cc of distilled water and titrated against N/10 hydrochloric acid, with phenolphthalein as indicator. If the number of cc of titration exceeds three, the bath should be treated with a suitable rectifier, such as ferrosilicon-boric acid for the medium temperature chloride baths, or with silica flour if bath is being used above 1800°F. When much alkalinity exists some trouble will be experienced with decarburization.

New Resin Core Sand Binder

A NEW synthetic resin core sand binder for aluminum and magnesium has been developed by Resinous Products & Chemical Co., Philadelphia. Identified as Uformite 580, this binder is a urea-formaldehyde resin, dust free and water dispersible. It may be added directly to mullers and other mixers without special handling.

Cores bonded with Uformite 580 are said to break down readily during solidification of the metal as the resin decomposes at the pouring temperature of aluminum and magnesium. The tendency to stick to core boxes is relieved by this binder, the company reports, and cores prepared with this material may be stored 4 to 5 hrs prior to baking without loss of tensile strength or surface hardness. Uformite bonded cores can be cured in 30 to 90 min at 325°F.

Cereals of the type used for giving green strength to the core sand are said to be waterproofed by Uformite 580, such cores retaining 40 pct or better of their strength when exposed to 100 pct humidity for 16 to 24 hr. Cores produced with this binder require no special equipment or special handling, the company reports.

Conveyorized Enameling Of Castings

Cast and stamped components to be cleaned, Bonderized, sprayed and baked are handled by a continuous chain conveyor, which in combination with specially-designed controls permits flexibility of functions and holds rejects to the neighborhood of 0.5 pct.

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THE requirements of speed, economy and flexibility, plus ability to turn out parts having a uniform high quality of finish, appear to have been met in the enameling unit designed by I-T-E Circuit Breaker Co. for use in its own Philadelphia plant. Although made partly from standard units, some of them altered to meet special requirements, the combination with specially-designed components make the system highly effective.

In this finishing setup, the use of an enclosed overhead chain conveyor helps to economize in space and, in combination with other features, makes it possible to handle a large volume of parts in a short time. Close control helps to maintain required quality and to hold rejects below 0.5 pct.

Flexibility is provided partly by controlling the speed of the conveyor and also by varying the quantity of heat supplied to the oven. In consequence, stampings, castings (both ferrous and nonferrous) and even molded plastic parts are handled through the equipment. Those that do not require Bonderizing are short circuited so as not to go through that process, or subsequent rinses. Even so, all parts are loaded, unloaded after finishing and are inspected at one station. All parts are loaded individually and there is no handling in baskets.

Fig. 1 shows the general plant layout with most of the conveyor shown in dotted lines. The normal circuit for ferrous parts and zinc diecastings is through cleaning, Bonderizing, hot-water spray, chromic-acid spray, dry off, enamel spray, baking, cooling and unloading. Parts that do not require cleaning and Bonderizing skip the processes shown in the left panel of fig. 1, and are hung on the conveyor just before it reaches the spray booth.

Loading is done from tables or tote boxes, where the conveyor dips, as shown at right in fig. 2, the conveyor then rising to enter the cleaner, shown at left. This cleaner is commonly used with trichloroethylene but can be adapted for an alkali cleaner if desired. Construction is of stainless steel, and includes steam heating coils. Parts passing downward into the cleaner first go through trichloroethylene vapor and then enter an area in which they are sprayed with this hot liquid solvent under high pressure so that mechanical as well as solvent cleaning (both vapor and liquid) results.

In leaving the cleaner, the conveyor rises through the spray and dips again as parts enter the Bonderizing tank in which the solution is heated to 180° F by steam that circulates through a welded coil of stainless steel, seen in the center of the tank, fig. 3. This tank is lined with stainless steel and the cover is made to lift off readily to facilitate cleaning. Water and Bonderite solution are added as needed to maintain the required concentration and make up for evaporation. The conveyor makes a loop in the tank but remains above the liquid level as parts, hanging from wire hooks, are submerged and carried through the solution.

Parts coming from the Bonderite tank (where they remain about 4 min) rise with the conveyor and enter an enclosure which first is filled with steam from the Bonderite tank; hence, any active salts remaining on the parts do not dry before the parts reach the hot-water spray area. There they are rinsed thoroughly by the hot high-pressure spray, pass through a runoff section and enter a spray of hot dilute chromic acid solution.

This spray, applied in a stainless-lined booth with

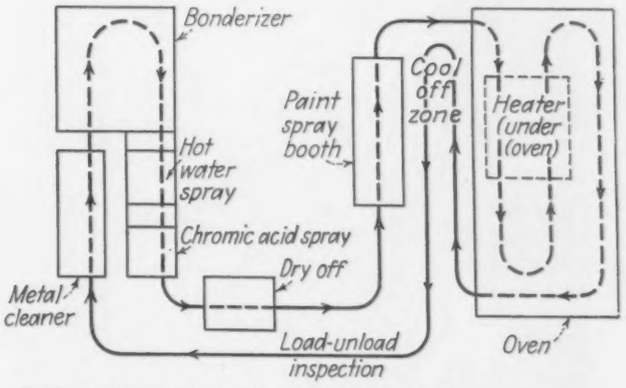
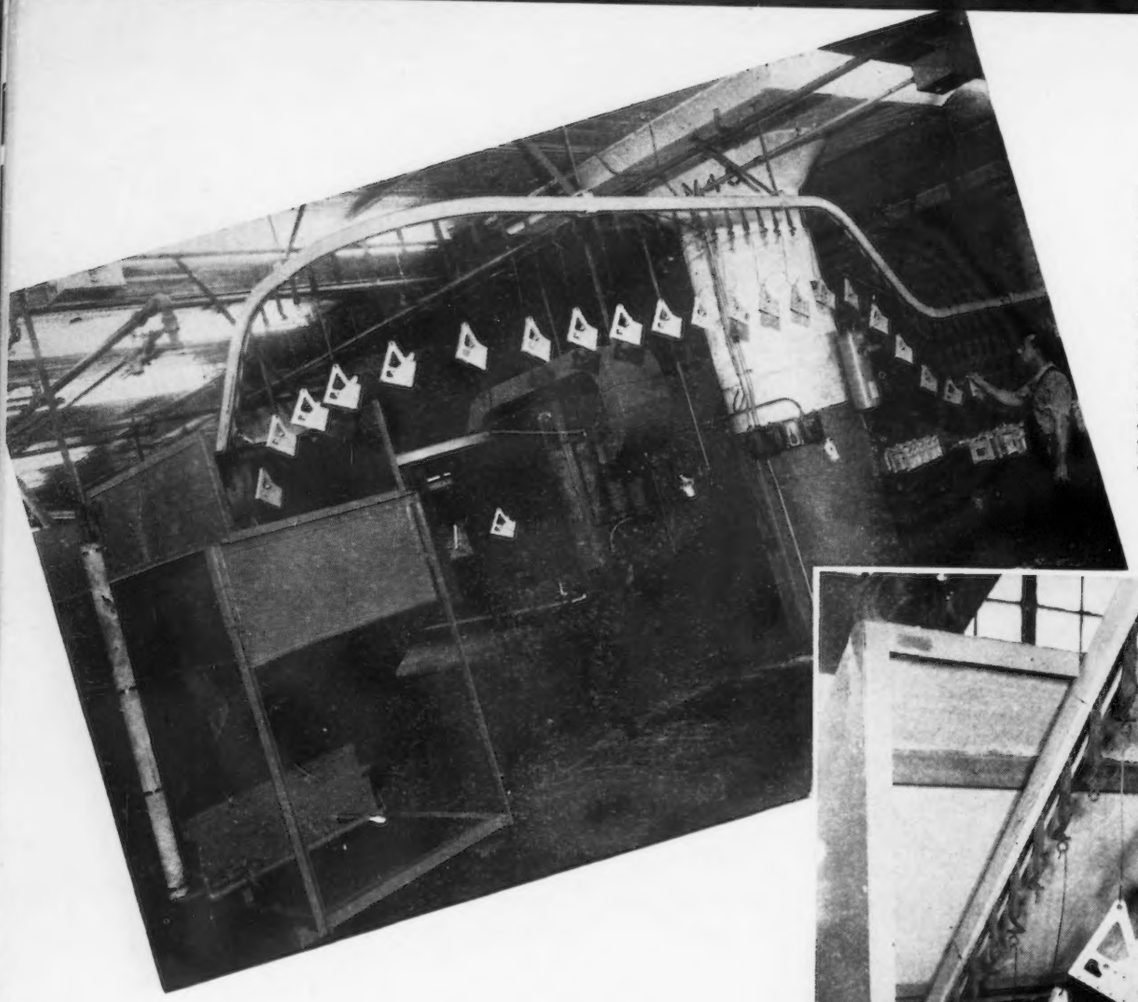


FIG. 1—General layout for cleaning, Bonderizing, rinsing, drying, spraying, baking and cooling of stampings, castings and plastic moldings on a continuous conveyor, in operation at I-T-E Circuit Breaker Co. Conveyor is shown partly in dotted lines with arrows indicating direction of motion.



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LEFT

FIG. 2—Zinc die-castings, placed on conveyor at loading station at right, pass into cleaner, left, and then are Bonderized. Castings at lower level, center, have been Bonderized and spray-rinsed, and are entering a short drying oven, part of which is back of the column.

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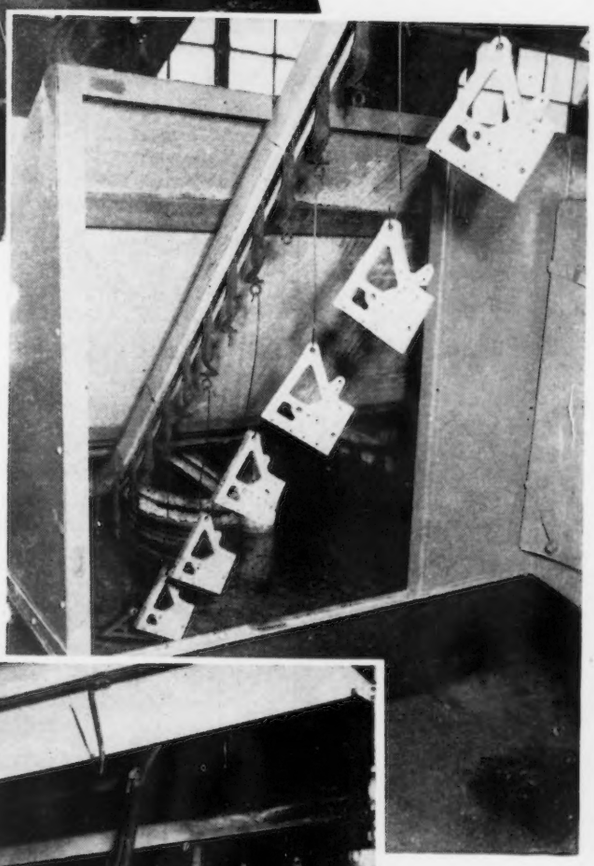

BELOW

FIG. 4—Spray booth through which parts are carried on swivel hooks by the conveyor. Over-spray is caught by the curtain of saponified water and is carried to a settling tank for recovery. Volatile constituents are sucked out by a high-velocity exhaust.

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ABOVE

FIG. 3—Diecastings are passing down the conveyor into the Bonderizing tank, which has a stainless steel steam coil for heating in the center. A loop of the conveyor carries castings through the solution around the coils.

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conveyor and hooks well shielded, neutralizes any salts left from Bonderizing. The latter produces on the parts treated a phosphate film that inhibits corrosion and provides an excellent base for the subsequent enamel. To this base, the enamel adheres tenaciously and is not subject to peeling or to any reaction between base metal and the finish itself.

After leaving the chromic-acid spray, parts enter a short dry-off tunnel oven and continue on the conveyor past the loading station, finally entering the booth where enamel is sprayed on while the parts continue in motion on the conveyor. The booth, fig. 4, is a De Vilbiss type but has been altered by providing at each end an opening through which the conveyor and its load pass. As all conveyor hooks are swiveled, the parts they carry are easily turned so that all surfaces are coated.

A standard spray gun, using a standard synthetic wrinkle enamel for nearly all parts, is employed. Spray not deposited on the parts is drawn by a high-velocity exhaust fan toward and over a water curtain on which the nonvolatile constituents are caught. The water is saponified by a special chemical treatment to help coagulate the over-spray and facilitate its removal and recovery in a settling tank. Volatile gasses are exhausted outdoors.

As sprayed parts leave the booth, they enter a duct near floor level and pass through in a quiescent atmosphere while the enamel sets before the conveyor carries the parts into a specially constructed bake oven in a separate room. In this oven, the conveyor rises to the top and passes the length of the oven three times, or about 90 ft in all, as baking proceeds. Longitudinal baffles divide the three passes.

Heat for baking is provided by a standard Ross oil-fired heat-exchanger capable of supplying 1 million Btu per hr. This heater is located below the oven. Heat is transferred to a stream of air, about one fourth of it drawn in fresh from outdoors, the remainder, from the oven, being recirculated. The fresh air replaces that exhausted from a zone where most of the fumes from the drying enamel are driven off, namely in the first few feet of the first pass where the hot air, at about 350° F strikes the freshly-enameled surfaces.

Heated air is discharged at three points into the oven: First, with parts-flow, near the point where parts enter the oven; second, counter to parts-flow from a point near the center of the second pass; and, finally, counter to parts-flow in the third pass. Heated air for recirculation is drawn from the final pass, a part of it from near the end of the pass close to the conveyor exit. One result of this arrangement is to make the air near the conveyor entrance and exit practically static so that there is almost no heat loss through these openings.

Fans controlling the air flow are of such capacity that air is changed in the oven about four times a minute, the quarter exhausted outdoors being replaced, of course, by fresh air that is heated and mixed with three parts of recirculated air. Fumes pass out with the exhausted air. Thermostats, controlling the heat supply, keep the temperature substantially constant (within about 10° F) throughout the oven. Parts commonly traverse the oven in 30 to 45 min and issue dry but hot.

To allow proper cooling before unloading, the conveyor makes an extra loop, traversing about 100 ft in room air before parts reach the unloading station. There are, in all, about 300 ft of conveyor, and when it travels at the normal speed of about 2 to 4 ft per min, the parts make the full circuit in about 2½ hr. The resulting finish is not only uniform in appearance but of high grade and well suited for prolonged service.

Parts that are Bonderized before enameling have the advantage, not only of insuring excellent adherence of the enamel but of high corrosion resistance, should moisture ever penetrate the coating. Even if the finish is scratched through to bare metal, by accident or abuse, any resultant corrosion will not spread under the remaining film (as rust does on untreated steel) because of the inhibiting action of the Bonderite film.

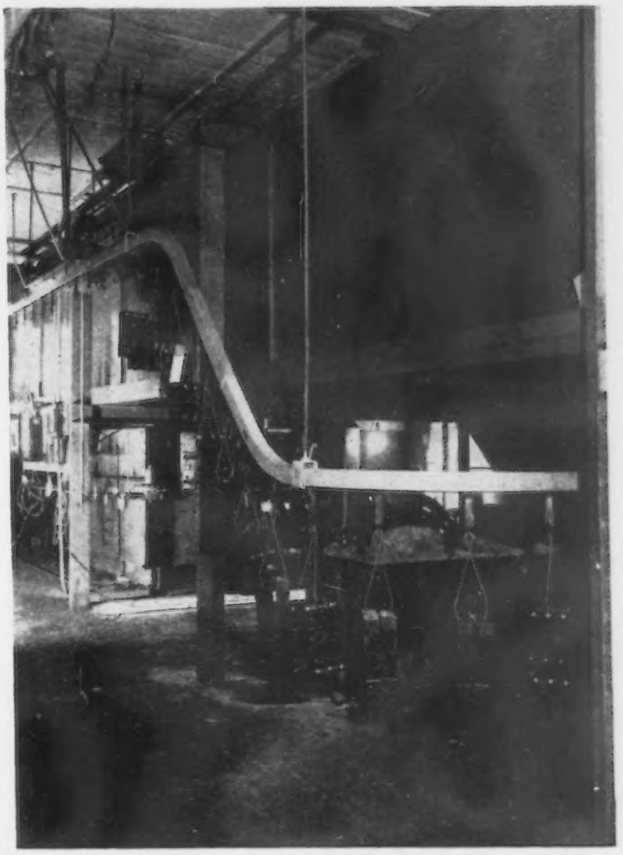

FIG. 5—Bakelite moldings that have been sprayed with insulating varnish and then baked are seen on the conveyor in the foreground after leaving the oven.

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Besides diecastings, sand castings and stampings, some phenolic plastic parts are handled through the spray booth and baking oven. These parts are given a coating of insulating varnish to prevent the formation of carbon tracks on the plastic in the event of electric arcing or flashover in service.

It can thus be seen that the finishing setup meets a variety of requirements and is capable of handling a large volume of parts which are quite diversified as to shape, size, material, surface smoothness and application.

The Welding Of Nickel-Alloy Steels

Having explored the metal-arc process of welding nickel-alloy steels, structural welding and fabrication of pressure vessels by welding in the first three sections of this series, the author completes his coverage of welding processes in this concluding article by discussing spot welding, upset butt welding, forge welding, oxyacetylene welding and oxyacetylene pressure welding.

By T. N. ARMSTRONG

Development & Research Division, International Nickel Co., Inc.

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RESISTANCE welding is an unusually broad term as it includes spot welding, projection welding, seam welding, flash and upset butt welding and other processes. Because of the limited application of resistance welding to low-alloy steels, only spot welding and flash welding are included in this discussion.

Spot welding consists of clamping two or more sheets of metal between two copper or copper-alloy tips and passing sufficient current through the pieces to weld them together. As resistance to the current is highest at the interface of the sheets and as the copper electrodes conduct heat better than steel, fusion occurs first at the interface of the sheets. By regulating current density, pressure of electrodes and the time the current flows, the weld is confined to a relatively small area.

Spot welding of the low-alloy steels has not been applied extensively to the SAE types as welds in these steels are brittle unless subjected to stress relief anneal or to full heat treatment. A spot welding machine is now available, however, with which lower current can be applied through the same electrode for stress-relief anneal subsequent to the welding operation. This equipment may extend the application of spot welding to a wider variety of steels.

Spot welding of the low-alloy, high-tensile, nickel-copper steels has been used extensively, particularly in railroad car construction. In general the welding current is slightly lower than for carbon steel, the steels are more sensitive to time and current values and welding pressures are slightly higher. These differences are due principally to the higher resistivity of alloy steels. These factors should be taken into consideration and the proper adjustments made when changing over from low-carbon steel to alloy steels of the same gage.

Flash Butt Welding—Flash butt welding is an electrical resistance welding process and as the term implies it is used to join metals with a butt joint. It can be applied to bars, tubing, plate, strip and other forms of products.[20]

In flash butt welding the material is heated by rapidly recurring short circuits of high electrical

Table XVII

Physical Properties of Flash Butt Welded Specimens

Draw Temperature, °F	Rockwell "C" Hardness	Yield Strength, Psi	Tensile Strength, Psi	Pct Elongation in 2 In.	Pct Reduction of Area	Brinell Hardness	
						Parent Metal	Weld Line
700	44	172,000	211,000	7.5	8.2*	476	476
800	43	182,000	201,000	12.0	51.2	463	462
900	41	178,000	198,000	13.5	50.5	445	448
1000	40	175,000	194,000	7.5	9.4*	448	447
1100	38	155,000	176,000	17.5	55.7	419	417
1200	26	121,000	131,000	20.5	65.0	300	299

* Broke in weld zone.

currents and the pieces joined by an impact forging pressure. The welds are made in a flash butt welding machine equipped with dies for holding the parts.

The irregular localized contact between the two lightly touching surfaces results in an extreme localization of heat at these surfaces caused by a series of fine short circuiting contacts. The points of metal contacting are repeatedly raised to the melting point and are blown out in the form of incandescent particles or sparks. This action generates sufficient heat to cause a small zone back of the molten surface to become plastic, and as the metal is blown out at the arcing surfaces the pieces are moved together to bring new points into contact. When the plastic zone extends the correct distance back of the molten surface the pieces are suddenly butted together with upsetting force, causing a forging action. The forging action pushes out the molten metal and extrudes part of the plastic metal.

Steels that possess high hardenability are usually preheated before welding to prevent cracking in the heat-affected zone. As the heat is quite localized in the flash butt welding process as in the metal arc process, localized hardened areas occur adjacent to the weld.

Preheating is performed by bringing the pieces together under pressure and the current applied intermittently. The pressure is too great to permit incandescent particles to be expelled but not great enough to upset the heated end. The preheating current is turned on and off to allow the heat to flow back from the contacting surfaces. When the proper preheat is obtained, the contact pressure is adjusted and the weld made. Two disadvantages of preheating are that it is manually controlled which may lead to irregularities and it requires higher power input than flashing.

Steels of high hardenability must be preheated and should be slow cooled from welding heat or subjected to heat treatment immediately after welding.

The metallurgical effects due to welding are so similar in flash butt welding and metal-arc welding that the same precautions are necessary in both processes when welding steels of high hardening capacity. The principal differences are that in flash butt welding no filler metal is introduced, the molten metal is squeezed out from the welding surfaces and the weld is made under pressure.

Until recent years flash welding in the ferrous field was confined mainly to the low-carbon steels. The process has been extended to the low-alloy steels and after heat treatment properties can be developed in the welds that are approximately equivalent to the unwelded material.

Flash-butt welds were made[21] on 1-in. diam round bars cut from 1½-in. plate of nickel-chromium-molybdenum steel of the following range of composition:

Pct C	Pct Mn	Pct Si	Pct Ni	Pct Cr	Pct Mo
0.25 to 0.25	0.80 to 1.10	0.20 to 0.30	0.80 to 1.00	0.60 to 0.80	0.50 to 0.60

After welding, the specimens were quenched and tempered to different hardness levels, turned down into 0.505-in. test pieces and tensile properties determined. Results of some of the tensile tests were as shown in table XVII.

In another series of tests made for the International Nickel Co., Taylor-Winfield Co. investigated the flash butt welding characteristics of SAE 2320. The steel investigated was of the following analysis:

Pct C	Pct Mn	Pct Si	Pct Ni
0.21	0.57	0.21	3.37

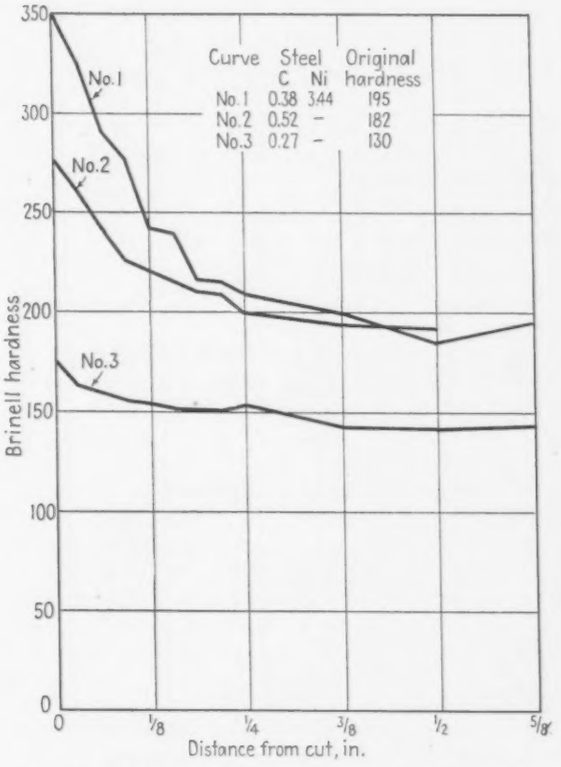

FIG. 12—Surface hardening effect of oxygen cutting (6½-in. billets).

Properties of specimens taken from across the welds were as follows:

Treatment after Welding	Yield Strength, Psi	Tensile Strength, Psi	Pct Elongation in 2 In.	Pct Reduction of Area
Tempered 1150° F.....	92,500	102,500	18.0	58.6
Water quenched and tempered 1200° F....	83,000	104,800	25.0	64.0

Flash-butt welds have been made on other direct-hardening, nickel-alloy steels, such as nickel- chromium-molybdenum steel A8640 and nickel-chromium steel SAE 3140. Experience has shown that with proper adjustment of the electrical setup, sound welds free from defects (usually referred to as "penetrators") can be made. After heat treatment the properties across the weld are approximately equal to the properties in the unwelded areas.

Bars from one heat of A8640 were tested for the

Table XVIII

Physical Properties of Welded and Annealed Specimens

Pct C	Pct Ni	Yield Strength, Psi	Tensile Strength, Psi	Pct Elongation in 4 In.	Pct Reduction of Area	Brinell
0.10	....	36,300	53,200	33.0	74.0	110
0.10	2.00	49,000	63,000	33.0	68.0	132
0.10	3.00	54,500	69,000	31.0	70.0	154
0.10	5.00	57,500	70,300	24.0	67.0	156

International Nickel Co. by Taylor-Winfield. Analysis and results after welding were as follows:

Pct C	Pct Mn	Pct P	Pct S	Pct Si	Pct Ni	Pct Cr	Pct Mo
0.39	0.80	0.018	0.023	0.024	0.52	0.51	0.20

The following values were selected as representative for specimens taken from across the welds.

Treatment after Welding	Yield Strength, Psi	Tensile Strength, Psi	Pct Elongation in 2 In.	Pct Reduction of Area
Tempered 1150° F.....	74,800	92,600	23.0	64.0
Water quenched and tempered 1200° F ...	104,000	115,000	24.5	60.0

Apparently little difficulty is encountered in flash welding the low-carbon nickel steels and the joints will have good properties if subjected to treatment after welding. Results[22] from one carbon steel and three nickel steels annealed at 1650°F after welding were obtained, as listed in table XVIII.

[20] *"Flash Butt Welding," by J. H. Cooper, J. J. Riley and J. C. Barrett,* THE IRON AGE, *April* 13, 27, 1944.
[21] *"Properties of Heat-Treated Flash Welds in Cr-Ni-Mo Steel," by J. C. Barrett, Welding Journal, May* 1944.
[22] *J. Gailbourg and M. Ballay, Revue due Nickel V 7,* 1936.

Upset Butt Welding

Upset butt welding consists of placing two pieces of metal together in contact so that their juncture form the place of highest resistance in an electric circuit. When an electric current of sufficient magnitude is applied, heating and subsequent fusion occur at the joint. The pressure, which is applied during the entire operation, is usually just sufficient to prevent arcing at the start and is increased until it is high enough to cause upsetting when fusion occurs.

The principal difference between flash welding and upset butt welding is that in flash welding there is very light contact or even a slight gap between the pieces, which causes arcing when the current is applied, and incandescent particles are thrown out. In upset butt welding the pressure is applied suddenly when the surfaces are at fusion temperature and the current is cut off when the upset occurs.

Although flash butt welding has displaced upset butt welding to a great extent, the latter process is still used in wire working industries. Low-carbon nickel alloy steels including SAE 2320, 4615 and A8620 have been used very extensively in the manufacture of high strength upset butt welded chain.

The advantages of upset butt welding are that there is no flash spatter, and the upsets are very smooth and symmetrical with little ragged extrusion. The disadvantages are lower weld strength, necessity for surface preparation, larger upset, and longer welding time than for flash welding.

Forge Welding

Forge or hammer welding is the oldest of the welding processes. Although it has been almost displaced by more recently developed processes, there are places where it is still applied both in regular production jobs and for making emergency repairs.

At one time nickel in steel was considered detrimental to forge welding because the tightly adhering oxide formed on heating nickel steels prevented a good bond of the metal surfaces. The commercial development of suitable fluxes overcame this difficulty and a flux prepared from a mixture of 30 parts by weight of steel filing and 100 parts borax has given very good results.

Hammer welds were made on a number of nickel-alloy steels using $\frac{3}{8}$x1-in. bars scarfed at 45° and applying a suitable commercial flux. The welded bars were then reheated to above the critical range, quenched in oil and tempered to a hardness of approximately 400 Brinell in the alloy steel. Although the welds were made by operators unskilled in this type of work little difficulty was experienced in making the welds, no cracking occurred and the flux appeared to be satisfactory. Results are shown in table XIX.

The weld efficiency was based on the strength of the weakest steel. The weld efficiency decreased as the carbon content of the steels increased although good joint strength was obtained in all cases.

Oxyacetylene Welding

Although the development of metal-arc welding with covered electrodes has displaced oxyacetylene welding of steel to a large extent, there are applications where oxyacetylene welding is not only more satisfactory but may also be more economical.

In gas welding the heat is applied more gradually than in metal-arc welding and the sharp thermal gradient immediately adjacent to the weld does not occur in the gas process. The amount of heat delivered is under the control of the operator and is not necessarily associated with the amount of metal melted as in the arc process. The flame may be directed at the weld or at any position adjacent to the weld which permits the operator to control the rate of cooling of the welded joint. This is of particular importance in welding alloy steels that are air hardening.

Gas welding of nickel steels is usually performed with a neutral or slightly reducing flame. In general, fluxes are not used in oxyacetylene welding of steel.

There is no difference in the procedure for gas welding nickel alloy steels from that used for welding carbon steel. Preheating is applied if the shape of the welded structure is so complex that high welding stresses may be set up or if the steel being welded has high hardening tendencies. Preheating is not restricted to the vicinity of the weld as it so often is in arc welding, but is usually applied to areas away from the weld where high stresses may be induced.

In general the practice is to use standard types of alloy steel rods for welding the low alloy steels rather than attempt to use rods of the same composition as the base materials. There are certain exceptions, however, where the alloy steel is being used for its special properties, such as resistance to creep at elevated temperatures which is characteristic of molybdenum steels or resistance to embrittlement at low temperatures which is characteristic of nickel steels. Another example is steels with small percentages of copper to resist atmospheric corrosion. In such instances the analysis of the weld should be similar to the analysis of the base material.

The mechanical properties of gas welded joints of nickel alloy steels approach the properties of the base material after heat treatment but seldom equal them. By selecting the proper filler rod and applying good welding practice, strength properties of the low and medium carbon steels can be equalled although ductility is usually slightly lower.

Gas Welding Rods—Presence of nickel in steel rods for gas welding is very beneficial as it improves the flowing characteristics and cuts down sparking. One commercial rod which contains approximately 0.15 pct max carbon and 1¼ pct nickel is credited with producing weld metal with the highest ratio of ductility to strength of any gas welding steel rod available. In the as welded condition all deposited metal will develop a minimum tensile strength of 62,000 psi and elongation in 2 in. of 22.0 pct.

Some of the most common nickel-containing rods are of the following composition:

Type	Pct C	Pct Mn	Pct Ni	Pct V
A	0.15 max	0.50	1.25	....
B	0.20 max	0.50	3.50	....
C	0.40 max	1.00	2.00	0.25

Table XIX

Results of Forge Welding Tests Using "E-Z" Flux

Welds SAE to SAE		Alloy Steel, Bhn	Breaking Stress, Psi	Weld Efficiency, Pct	Comments on Failure
3140	1020	342	88,500	<100	Some adhesion
3140	1020	332	74,100	93	
3140	3140	347	120,000	69	
3165*	1020	444	54,700	68	Large oxide inclusion
3165	1020	425	64,200	80	
3165	3165	444	63,200	28	Some oxide in weld
3165	3165	441	68,500	31	
4640	1020	405	77,600	100	In carbon steel
4640	1020	415	66,200	83	Largely in C steel
4640	4640	387	87,500	45	
4660*	1020	405	60,800	76	
4660	1020	415	59,700	75	
4660	4660	415	123,000	59	
4660	4660	418	129,200	62	Adhesion at ends of weld

* Not standard SAE steels, but conform in alloy content.

Silicon content of gas welding rods usually within the range 0.25 to 0.50 pct.

Type A is an all-purpose rod for welding carbon and low-alloy steels. It is a very easy rod to handle and develops good strength and ductility.

Type B is used sometimes for welding piping that is to be used in low temperature service and it has also given excellent service in welded vessels for storing caustic. Its principal use, however, has been for putting down underlays for hard-facing materials.

Type C has been very popular for welding battered rail ends. Welds made with this rod are mildly air hardening, consequently are sometimes used for resisting abrasion. Very high strengths are developed in these welds by quenching and tempering, although ductility will be lower than in the base material.

Nickel up to about ½ pct is frequently added to carbon-molybdenum rod to give it better welding

Table XX

Composition of Rods and Properties of Deposited Metal From Gas Welds

Rod No.	Weld Treatment	Pct C	Pct Mn	Pct Si	Pct Ni	Pct Cr	Pct Mo	Other Elements	Yield Strength, Psi	Tensile Strength, Psi	Elongation Pct in 4 In.	Reduction of Area, Pct	DVMR* Notch Impact mkg per sq cm
1	W	0.11	0.86	0.22	....	....	....	....	39,000	62,000	33.3	64.0	16.6
1	N	....	....	....	....	....	....	....	44,500	64,000	32.0	69.0	17.0
2	W	0.13	1.00	0.34	1.04	....	....	....	41,000	70,000	27.3	51.0	12.6
2	N	....	....	....	....	....	....	....	48,000	68,500	29.5	63.0	16.7
3	W	0.13	1.01	0.30	0.89	0.35	....	....	44,000	72,000	27.3	55.0	12.4
3	N	....	....	....	....	....	....	....	48,000	67,500	26.1	54.0	16.6
4	W	0.12	1.02	0.33	0.89	....	....	0.24 Al	47,500	66,500	16.2	33.0	11.8
4	N	....	....	....	....	....	....	....	46,000	63,500	31.2	68.0	16.4
5	W	0.12	0.95	0.37	0.88	....	0.27	....	45,500	73,500	21.1	51.0	10.3
5	N	....	....	....	....	....	....	....	44,000	70,500	24.5	51.0	15.1
6	W	0.12	0.97	0.31	0.83	....	....	0.25 V	63,500	76,000	10.9	38.0	10.3
6	N	....	....	....	....	....	....	....	55,000	71,000	26.0	54	17.d
8	W	0.18	1.17	0.44	0.90	....	....	0.33 Ti	48,000	79,000	13.1	26.0	10.4
8	N	....	....	....	....	....	....	....	49,500	71,000	18.7	35 0	13.5
9	W	0.16	1.06	0.56	0.89	0.37	....	0.14 Ti	49,000	79,000	11.3	23.0	10.7
9	N	....	....	....	....	....	....	....	56,000	75,000	15.5	31.0	12.7
10	W	0.19	1.18	0.46	0.86	0.34	0.23	0.26 Ti	72,500	90,000	7.7	24.0	6.0
10	N	....	....	....	....	....	....	....	49,500	85,000	9.8	25.0	8.6
11	W	0.19	1.17	0.41	0.89	0.36	0.27	....	65,000	80,500	9.0	24.0	8.0
11	N	....	....	....	....	....	....	....	41,000	73,500	17.6	33.0	11.0

Results are average of two specimens, using forehand technique with 0.16 diam rod.
(W) After stress of relief anneal 1120°F for 2 hr.
(N) After normalizing 1670°F for 30 min.

* German-type specimens.

characteristics and to provide higher ductility in the joint.

Theis and Zeyen[23] investigated the gas welds made with alloy rods of various compositions to determine the most suitable for making butt welds in two types of boiler plates having tensile strengths of 58,500 psi and 70,000 psi respectively. Composition of the welding rods and tensile and impact properties of all deposited weld metal after stress relieving 2 hr at 1120°F (W) and after normalizing 30 min at 1670°F (N) are shown in table XX.

Oxyacetylene pressure welding is accomplished either by abutting the clean matching faces of two sections to be welded under moderate pressure and heating the joint by means of one or more oxyacetylene flames to a temperature of about 2200° to 2275°F until upsetting of the joint occurs, or by leaving a space between the matching surfaces during heating to desired temperature and then applying pressure. The completed joint has a definite bulge or upset at the weld, but the fillets are smooth and well rounded, since there is no sharp heat gradient.

The process has been used for welding railroad rails, pipe, bars, plate and oil well to joints.

Oxyacetylene pressure welding is solid phase welding as the members are bonded by atomic force without the presence of a liquid phase at any stage during the process. Cleanliness and close mating of the pieces are essential. The two pieces to be welded are brought together under pressure at the matching surfaces and the pressure maintained throughout the operation. Heat is applied by means of a torch or burner, care being taken not to generate appreciably higher heat at the interface than in the adjacent metal. When the joint heats to above a certain temperature an upsetting action occurs which aids in bringing the surfaces into intimate contact and provides reinforcing. After a short time at temperature the part is allowed to cool. The piece may then be either subjected to a stress relief anneal or to full heat treatment. If the weld has been correctly made a joint results which is indistinguishable from the base metal either by means of microscopic examination or by physical tests.

Indications are that the percentages of alloys present in the low-alloy steels exert little influence on the quality of pressure welds. Nickel-chromium steel, SAE 3140, oil well tool joints, and nickel-chromium-molybdenum steel, SAE 4340, airplane landing gear parts have been welded successfully by the process. Chromium-nickel stainless steel has been welded to carbon and low-alloy steels and iron-nickel alloys have been welded to chromium-nickel stainless steel.

The process has many advantages; one of the outstanding ones is the ability to make welds with high joint efficiency in the field far removed from shop facilities.

The application of the oxyacetylene torch for cutting steel is so general that no description of the process is necessary. Flame cutting operations are so frequently used in combination with welding that the two processes have become associated in the metalworking industries.

The low-alloy steels respond to oxygen cutting no differently than carbon steel. As in welding, the differences are not evident in the operation itself but show up in adjacent metal through thermal effects. When steel is cut with an oxygen jet, considerable heat is transferred to the walls of the kerf, resulting in rapid heating of a narrow zone to above the critical range. Heat is conducted away from the cut so rapidly by the mass of cold metal that the cooling rates of the zone heated above the critical range are comparable to those secured by liquid quenching.

Carbon steels containing not more than 0.30 pct carbon and most nickel alloy steels, containing not over 0.25 pct carbon usually do not increase in hardness sufficiently to interfere with most machining operations. However, hardness readings on the torch-cut face of the comparatively heavily alloyed steels, such as SAE 3312, 2512 and 4320 may be misleading as quite often retained austenite will be present.

The high-carbon steels and the direct-hardening grades of the low-alloy steels develop such high hardness at the torch-cut face that cracking may result from cooling stresses.

Preheating is recommended for steels of high hardening capacity and the preheating temperature usually employed is within the range 600° to 1100°F. Preheating temperatures on the low side of the range are preferred as it is difficult to make a smooth cut if the preheating temperature is too high.

Finished steel products such as plates, bars, forgings and castings that have high hardening capacity should be subjected to thermal treatment such as a subcritical anneal at 1100°F to 1200°F or to full heat treatment after flame cutting and before fabricating. One method that has been used extensively is flame softening by means of an oxyacetylene flame. The temperatures may be carried to above the critical, in which event some means are employed to provide slow cooling, or the temperature may be limited to below the critical so that slow cooling is not necessary.

In flame cutting nickel-alloy steels the resistance of nickel to oxidation causes the cut edge to build up in nickel content as shown in the following results secured by Cady[24] on two 3½ pct nickel steels cut with oxygen.

	Original Metal		Metal at Cut Edge	
SAE No.	Pct C	Pct Ni	Pct C	Pct Ni
2320	0.20	3.47	0.48	9.28
2345	0.45	3.44	0.82	10.34

Due to increase in nickel at the cut edge, hardness increases considerably and in some cases an austenitic layer is formed.

The distance the hardness penetrates depends on the composition, the thickness of the material cut and to some extent upon manipulation of the torch. With thicknesses exceeding 24 in. hardening does not penetrate over ⅜ in., while in cutting ½-in. plate the depth of the heat affected zone is only about 1/32 in. Fig. 12 shows the hardening effect in cutting 6-in. billets of three different steels.[25]

[23] *A Theis and K. L. Zeyen, Autog. Metallb.*, 57-65, 1940.
[24] *J. R. Cady, Welding Journal Res. Sup., September* 1940.
[25] *The Welding Handbook*, 1942, *American Welding Society, New York, N. Y.*

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EARLE C. SMITH, recipient of the ASM gold medal (left), Charles H. Herty, Jr., ASM president, and Kent R. Van Horn, ASM past president and presiding chairman of the annual banquet. Mr. Smith is chief metallurgist, Republic Steel Corp., while Mr. Herty is assistant to operating vice-president, Bethlehem Steel Co. Mr. Van Horn is manager, Cleveland research division, Aluminum Co. of America Research Laboratories, past president of ASM and present president of the American Industrial Radium and X ray Society, Inc.

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METAL CONGRESS

. . . First postwar meeting at Cleveland gives industry a preview of peacetime future of war-spawned improvements in materials, equipment and processes.

OUTLINES of the picture of what post war America can well be were sketched in last week in Cleveland, despite a distracting background of industrial strife, hotel room shortage and inclement weather. The picture delineated by the nation's leading metallurgists, engineers and metal plant executives attending the 27th national Metal Congress and Exposition placed dramatic emphasis upon the steady progress of science, in contrast with the well known cultural lag of political and economic development.

Cold statistics of attendance, number of papers presented, etc., are a poor means of measuring the success of an undertaking of so many phases as the metal show. Considering the congress from the viewpoint of its educational achievement, it was undoubtedly most successful. There was abundant support of this in the opinions frequently expressed by those attending the show. The approximately 50,000 persons who passed through the exhibit, the crowds constantly gathering at booths, the questions and problems put to the engineers at the exhibits, provided ample support for the statement that the past week's metal show was in fact one of the most successful expositions held under the aegis of Bill Eisenman, grand preceptor and guardian angel of metal shows.

The sponsoring societies, the American Society for Metals and the American Industrial Radium and X ray Society, both had unusually interesting technical programs. Abstracts of some of the outstanding papers read at the technical meetings are published elsewhere in this issue.

It is unfortunate that one of the most interesting technical sessions, the round table discussion on super-alloys for high temperature service in gas turbines and jet engines, cannot be discussed in this report. Although considerable information on some of the subjects discussed in this open meeting have already appeared in print, censorship still in effect prevents publishing any worthwhile report of that discussion.

It can be said, however, that the metallurgists participating in the roundtable, under the chairmanship of C. T. Evans, Jr., chief metallurgist, Elliot Co., were quite unanimous in the feeling that the problem of developing equipment which must perform at temperatures up as high as 1600 and 1800°F with an eco-

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nomic life is a problem calling for comprehensive collaboration between the metallurgist and the design engineer.

The authorities participating in the round table discussion of atomic energy, under the chairmanship of C. S. Smith, director of Metals Institute, University of Chicago, succeeded in squelching some of the Buck Roger's conceptions of atomic energy by emphasizing that physicists engaged in atomic energy research are definitely not likely to set off an uncontrolled chain reaction that would destroy the earth.

The annual ASM banquet on Thursday was easily the highspot of the congress. Kent R. Van Horn, manager of the Cleveland Research Div. of Aluminum Co. of America Research Laboratories and past president of the ASM, presided at the banquet. Gerald Wendt, editor of Science Illustrated, was the principal speaker of the evening. In his address, "The Atomic Age," Mr. Wendt declared that one of the greatest dividends of the machine is not more goods, but time—time to live.

ANNUAL ASM banquet at the Hotel Statler, Cleveland, with Kent R. Van Horn, ASM past president and present president of the American Industrial Radium and X ray Society, presiding. Following the presentation of awards, Gerald Wendt, editor of Science Illustrated, spoke on "The Atomic Age."

The annual presentation of awards served, in a manner, to turn the spotlight on some of the unsung heroes of the war—metallurgists whose contributions played such a vital role in the successful prosecution of the war.

The ASM medal for advancement of research was awarded to Gerard Swope, honorary president, General Electric Co. Mr. Swope was unable to attend the meeting and the medal was accepted by Zay Jeffries, vice-president, General Electric Co., on Mr. Swope's behalf. The citation accompanying the medal awarded to Mr. Swope emphasized his preeminent share in many of the important developments in metallurgy in recent years. His support of fundamental and applied research has produced a profound effect on the metallurgical science of his time.

Earle C. Smith, chief metallurgist, Republic Steel Corp., was the recipient of the ASM Gold Medal. The presentation was made in recognition of his outstanding metallurgical knowledge and mature ability in the diagnosis and solution of metallurgical problems. In making the presentation, particular emphasis was placed on Mr. Smith's part in the development of contact metallurgists. The citation also stressed his constructive influence in developing an appreciation and understanding of the effects of grain size.

The Albert Sauveur Achievement Award was presented to Robert S. Archer, metallurgical assistant to vice-president, Climax Molybdenum Co. The award to Mr. Archer was based in a large measure on his important contributions to the knowledge of fabricating, compounding and heat treating aluminum alloys. It was pointed out that three alloys described in patents bearing his name may be said to form the basis upon which the present aluminum forging industry is built.

As authors of the paper judged of highest merit presented before the ASM and published in the society's official publication, the 1945 Howe medal was awarded to Morris Cohen, Stewart G. Fletcher and

Metal Show Echoes

• • Sid Hix, in this cartoon, has captured much of the spirit, or rather confusion, of a metal show. It is a moot question, tho, as to whether or not the very capable midgets that assisted in the Lindberg Engineering booth were considered by visitors to be adequate replacement for the charming blonde hostesses which have graced the Lindberg exhibit in the past.

• • Many small fry visitors, surfeited with popular comic strips, were visibly disappointed in not finding Buck Rogers & Co. exhibiting the very latest in jet propulsion.

• • The combination of the hotel room shortage and the inclement weather brought the recommendation from visitors that the convention housing bureau consider in the future the use of dog sleds as a safer and surer means of reaching some of the emergency lodgings in the more distant suburbs of the city.

WELCOME A.S.M. MEMBERS
YOU SAY SHE HEATS UP FAST AND IS EASY TO CONTROL? WHAT'S HER 'PHONE NUMBER?
I'M TALKING ABOUT THAT NEW ALL-PURPOSE BRAZING FURNACE!
HOW DID I GET CAUGHT IN THIS JAM? I WANT THE LADIES' LOUNGE!
THE HOTEL ROOM SHORTAGE DOESN'T BOTHER ME.... I ALWAYS SLEEP UNDER THE TABLE ANYWAY!
SOME OTHER TIME, SUGAR! I GOTTA SEE A MAN ABOUT A FURNACE!
DID YOU GET MY HOTEL ROOM? I SLEPT ON THAT LAKE BOAT LAST YEAR AND GOT SEA-SICK!
ASM
HOTEL INFORMATION
NOT A BAD EXHIBIT! DID YOU SEE THAT CYCLONE?
CYCLONE?! THAT REMINDS ME—I FORGOT TO CALL MY WIFE!
TO THE LINDBERG EXHIBIT
REMEMBER, OUR FIRM SENT US UP HERE FOR BUSINESS...NO FOOLING AROUND!

Courtesy Lindberg Engineering Co.

Dara P. Antia. The paper on which the award was based was entitled "Structural Changes During the Tempering of High Carbon Steel," and was based on portions of theses submitted by Messrs. Antia and Fletcher for a doctorate degree at MIT.

Dr. Cohen is associate professor of metallurgy at Massachusetts Institute of Technology, while Mr. Antia is now associated with the Indian Aluminum Co., Calcutta, India. Mr. Fletcher is chief metallurgist, Latrobe Electric Steel Co.

The ASM president's medal was awarded to Marcus Grossman, director of research, Carnegie-Illinois Steel Corp., and ASM president in 1944.

to describe adequately all the outstanding phases of the exhibits. However, one of the particularly noticeable features of the equipment exhibition, both from the point of number of exhibitors as well as interest shown in the exhibits, was the equipment, for nondestructive examining and testing of materials. This equipment ranged from high voltage X ray and supersonic units, magnetic particle and fluorescent penetrant methods, through a simple surface transfer method.

Other developments of unusual interest included the welding method whereby weld metal in the form of a powder is introduced to the joint through an

View of some of the exhibits at the 27th Annual National Metal Congress and Exposition.

The annual Campbell Memorial lecture more than maintained the high standard of excellence set by earlier Campbell lecturers. This year's lecture was delivered by Maxwell Gensamer, head of the department of mineral technology, Pennsylvania State College. The lecture, entitled "Effect of Alloying Elements on Mechanical Properties," was concerned primarily with the problem of explaining quantitatively how alloying elements in solid solution, and undissolved compounds distributed in those solid solutions, affect mechanical properties.

The Lester Lecture, an annual feature of the meeting of the American Industrial Radium and X ray Society, was delivered this year by O. R. Carpenter, Babcock & Wilcox Co. The lecture dealt largely with the use of non-destructive inspection methods for determining quality of welds. Abstracts of both the Campbell Memorial Lecture and the Lester Lecture are published elsewhere in this issue.

The equipment and material exhibition held in the Cleveland municipal auditorium in conjunction with the congress was so vast in scope as well as in size as to make it impractical in the space available here

aperture in the nozzle of the gas torch. A neutral gas is utilized for carrying the powder from the storage chamber to the weld.

Notable refinements in material handling equipment, especially in industrial electric trucks, were very much in evidence. One booth exhibited samples of continuously cast bronze tubing of varying sizes and was never lacking interested visitors. Another exhibit of interest was one displaying a stainless part which had been formed with a plastic protective coating covering the metal during the forming operation, the coating serving to eliminate die marks from the polished surface of the formed sheet.

Several operating exhibits which attracted attention were those illustrating the versatility of pantograph gas cutting machines. The accuracy of reproduction and the complicated forms that were duplicated on a semi-production basis was quite unusual.

A number of new hydraulic pumps as well as additions to standard hydraulic lines were exhibited, including one very compact unit which was capable of producing pressures of up to 10,000 psi. Improve-

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NOTABLES at the speakers' table included (Left to right) Morris Cohen, Massachusetts Institute of Technology, co-recipient of the Howe Medal; L. S. Bergen, president, Bergen Precision Castings, Inc., and ASM trustee, and S. G. Fletcher, Latrobe Electric Steel Co., co-recipient, with Dr. Cohen and Dara P. Antia, of the Howe Medal.

o o o

ments in atmosphere generators for heat treating indicate the possibility of controlling the treatment to limits not previously considered practical on production basis.

Producers of precision castings and precision casting equipment were represented by a number of booths, containing many unusual examples of the close tolerances and relatively fine finishes possible in this type of work. Precision casting, which was developed primarily as a war baby will unquestionably find extensive use in peacetime products, according to a concensus of opinion of engineers studying the samples on exhibit.

Lathe files made with teeth of sintered carbide drew considerable interest in view of the possibilities of greatly increased life promised for such files.

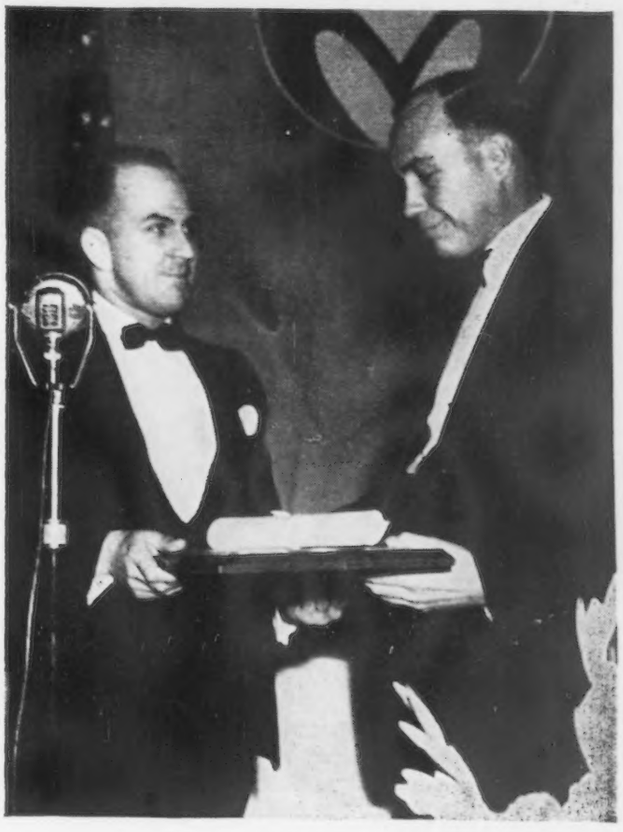
An exhibit illustrating the technique for reclaiming non-ferrous battlefield scrap contained a number of interesting features. The scrap is melted in a reverbatory furnace and transferred in the molten state to another furnace which brings the temperature of the metal up to 3500° F. This superheat furnace is built with a wall of 18-in. solid carbon block wool and employs carbon resistors to obtain the superheat.

At the proper temperature, a gas, such as nitrogen, is introduced to prevent burning of the carbon block. While the metal is being held at the superheat, the zinc, in the case of brasses, rises to the top, vaporizes and is drained off, condensed and collected in pigs. The remaining metal is refined in the usual manner. A plant utilizing this equipment has been in operation, it was said, for over a year. This plant handles copper material, such as shells, and has a capacity of up to 2000 lb per hr.

This same procedure, it was stated, can be employed to handle nickel alloys.

The equipment exhibit this year had a distinct international atmosphere with technical and purchasing representatives from Holland, France, Russia, China, India, Belgium, Denmark and South America very much in evidence. Representatives of European countries were especially interested in prime movers, machine tools and such basic industrial units as rolling mills, forging machines, etc. A secondary interest was in perishable tools. Russia recently received funds for and priorities for acquiring small tools and showed deep interest in new developments in that line. Representatives from South America appeared to be primarily concerned with establishing sales outlets there for finished American products.

ROBERT S. ARCHER, metallurgical assistant to vice-president, Climax Molybdenum Co., is awarded the Sauveur Achievement medal by K. R. Van Horn, past president of ASM who presided at the banquet.



MAXWELL GENSAMER

. . . Effect of Alloying

By MAXWELL GENSAMER
Head, Department of Mineral Technology, Pennsylvania State College

IN this, the twentieth Campbell Memorial lecture, attention will be concentrated on the problem of trying to understand *quantitatively* how alloying elements in solid solution, and undissolved compounds distributed in these solid solutions, affect mechanical properties.

Broadly, there are two aspects to what is meant by mechanical properties. These are succinctly called strength and ductility. By strength is meant the resistance of a substance to distortion or fracture, and by ductility is meant how much it may distort before fracture. There are many ways to measure these. The author chooses to concentrate on the simple tension test, for it is believed to yield as much or more information than any other test. Indentation hardness, which has been widely used, yields much less information, and those who have used it *only* have missed much of interest. Even the tension test alone is inadequate to complete understanding, but by and large other tests are useful to supplement what the tension test can tell. This applies particularly to measurements of strength, for which the tension test is almost wholly adequate; but it does not apply so well to ductility, where the conditions of loading are much more important and much less well understood in their action.

There are two aspects to what is meant by strength. These are, first, resistance to flow, and second, resistance to fracture. Both are functions of numerous variables, and can only be plotted on two-dimensional space by ignoring or holding constant all the variables but one. Both must be thought of as surfaces in multidimensional space. Among the variables which may influence both the flow and fracture stress, aside from composition and structure which are of principal concern in this paper, it should be noted that strain, time rate of straining, and temperature are the ones that most commonly are taken into consideration. If the resistance to flow and the resistance to fracture are plotted against strain, the two curves may be referred to simply as the flow curve and the fracture curve, for the effect of deformation on strength is most familiar. Then the effect of the other variables is to shift these curves.

What is meant by stress and by strain in plots like this needs discussion. The state of stress at a point requires for its description, ignoring the *orientation* of the element of volume of the material under discussion, that the values of the *three* principal stresses be given. Only if a *function* can be found of the three principal stresses, by *experiment* invariable among the three principal stresses, is it possible to plot a single quantity and call it the resistance to flow (or fracture) without reference to the particular values of the three principal stresses. Unless this principal stress invariant can be found, the ratio of the other two principal stresses to the one plotted as the resistance must be considered among the variables. And so with strain. As a first approximation, the von-Mises criterion for flow, sometimes called the shear-strain-energy, comes pretty close to providing this stress invariant for flow; but it is not exact, depending at least on the average value of the three principal stresses. And as to the fracture strength, even an approximate stress invariant still has not been found.

There are many experimental difficulties in the way of finding a principal stress invariant for fracture, or for that matter measuring the fracture strength for any but special values of the variables affecting it. The principal stresses at fracture are usually unknown because of "necking down," which precedes fracture in most circumstances for ductile metals. When the material is relatively brittle, so that fracture precedes necking down, it is not too difficult to obtain a particular point on the fracture curve; it is that point where the fracture curve crosses the flow curve, which is when the metal breaks. Up to that time the metal is flowing because the resistance to fracture is less than the resistance to flow. And up until that time it is not possible to know where the fracture curve lies.

So, without changing any of the other variables,

Elements on Mechanical Properties

Abstract—Twentieth Campbell Memorial Lecture

only *one* point on the fracture strength curve can be gotten. This so complicates the problem that no one as yet has found out how to determine the course of the fracture curve, for the general case when both flow and fracture are affected by all the variables at their disposal. If a variable could be found that would affect the flow curve but *not* affect the fracture curve, then by changing *that* variable it is possible to procede along a series of flow curves to the breaking point on a *single* fracture curve, and so get enough points to plot it. It has been suggested that temperature is such a variable, and that changing the temperature shifts the flow curve but not the fracture curve. The author is afraid this is a vain hope, although it is true that the flow stress is affected more by changing the temperature than is the fracture stress.

High Speed Tensile Tests

Zener and Hollomon have made a pretty good case for a single-valued functional relationship between speed of testing and temperature. If such an equivalence is borne out by more experience, then changing the speed of testing should be equivalent to changing the temperature, and tests carried out at different speeds should result in fracture at different limiting strains, that is, ductility should vary with the speed of testing, the way it does with temperature. Unfortunately, some of the author's experience with high-speed testing in simple tension does not confirm this; high-speed tensile tests on steel result in the same tensile reduction of area as slow speed tests. Either speed and temperature are *not* equivalent, or what is more likely, resistance to flow and resistance to fracture are both affected, and in such a way as to yield the same deformation at fracture. *But* then, such high-speed tests are open to questions of interpretation. Because of the limited speed of propagation of a plastic wave, it may be that the actual rate of deformation at the instant of fracture is independent of the speed with which the cross-heads of the testing machine are moving apart, or at least it may be that even very fast rates of testing fail to achieve a high rate of unit deformation at the point of fracture. Here is one of the important and annoying complexities encountered in high-speed testing.

It is then necessary generally to ignore the fracture curve and to discuss the subject in terms of the flow-curve and either the deformation or stress at fracture, which is unfortunate because it cannot give the whole story. But, to do the best that can be done, consider first the flow curve, then ductility.

The discussion of the effects of composition and structure on the flow strength of metals is to be based on the stress-strain curve obtained in tension. The very general applicability of tension curves to flow under other conditions of loading shall be referred to a little later. It is thought advisable to discuss now the methods used to analyze tension test data, methods which make the wide applicability of the tension test more apparent, and which have led to simplification of the relationships between composition or structure and the tensile properties. For a typical iron alloy, data may be plotted in several ways, stress against strain or load against strain. And a plot may be made of the logarithm of the stress against the logarithm of the strain. It is the writer's experience that, over the whole of the stress-strain curve *in which confidence is possible*, the curve is always a straight line when plotted logarithmically. Beyond the point where necking down begins, there are departures from the straight-line plot for which quantitative corrections can not be made; these departures result from the circumstance that there is no longer simple tension after necking down begins, from the increase in speed of deformation when it is localized by this necking down, and possibly from some reorientation effects. It is only fair to assume that the curve would be straight to the point of fracture *if* these disturbances could be avoided.

Effect of Necking-Down

It is of interest to follow the plotting of a point on the final logarithmic curve, all the way from the original data to the final straight-line plot. Necking down begins at the maximum load (or maximum in load divided by original area, which is what is plotted here). If it were not for necking down, it would be possible to go from a load or *nominal* stress versus extension curve to a load versus reduction-of-area curve by calculation. Up to the time of necking-down the one curve can be calculated from the other, by using the fact that the volume or density of a metal is unchanged by plastic deformation, requiring constancy of the product of length by area. But after necking-down, this calculation is not possible, for the overall extension depends on the distribution of deformation.

To get a true stress-strain curve it is necessary to have the area, which must be measured after necking-down begins. For each point then the diameter must be measured, at the point where it is least, at the center of the necked-down region. From the area we may calculate the strain, using always the logarithmic strain when the strains are large. The logarithmic strain takes into account the fact that the gage length is changing throughout the test, and it may be regarded as the true strain; it is simply the integral of dl/l, instead of $\Delta l/lo$, the conventional strain.

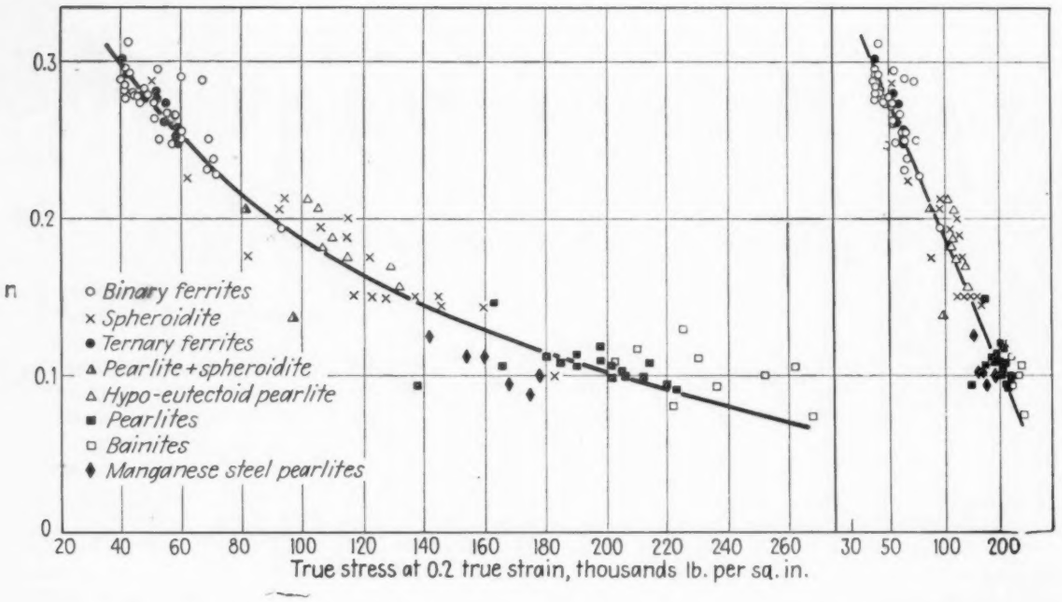


FIG. 1—There is a fairly definite relationship between the flow strength and the strain hardening exponent.

Dividing the load by the actual area gives the apparent true stress. This, however, is in need of correction because there are lateral tensile stresses in the necked-down region, which lead to higher average stress than would be the case if simple tension prevailed; and, unless the test is run very slowly, the rate of straining may be high. Bridgman has attempted to calculate the correction required by the presence of lateral tensile stresses, but his correction is in the writer's experience not quite enough; the corrected points still lie a little above the straight line in the log-log plot of stress versus true or logarithmic strain.

The fact that the log-log plot is a straight line means that all these tensile curves are general parabolas, fitting equations of the form $\sigma=\sigma_1 \delta^N$, where σ is the true stress, σ_1 is the true stress at unit strain ($\zeta=1.0$), ζ is the true strain ($\ln l/l_0$), and n which may be called the strain-hardening exponent; it is the slope of the log-log plot. It is interesting to note that the rate of strain hardening, $d\sigma/d\delta$, obtained by differentiation of this equation, is equal to $6/\delta n$, that is, the ratio of the stress to the strain multiplied by n; the greater n, the greater the rate of strain hardening. The constants which describe *completely* the whole course of the corrected stress-strain curve are then σ_1 and n.

The writer has chosen to discuss, not σ_1, but the stress for a strain of 0.2, which we have called $\sigma 0.2$. The reason for this is that the σ_1 value is influenced much more by how the line is drawn through the

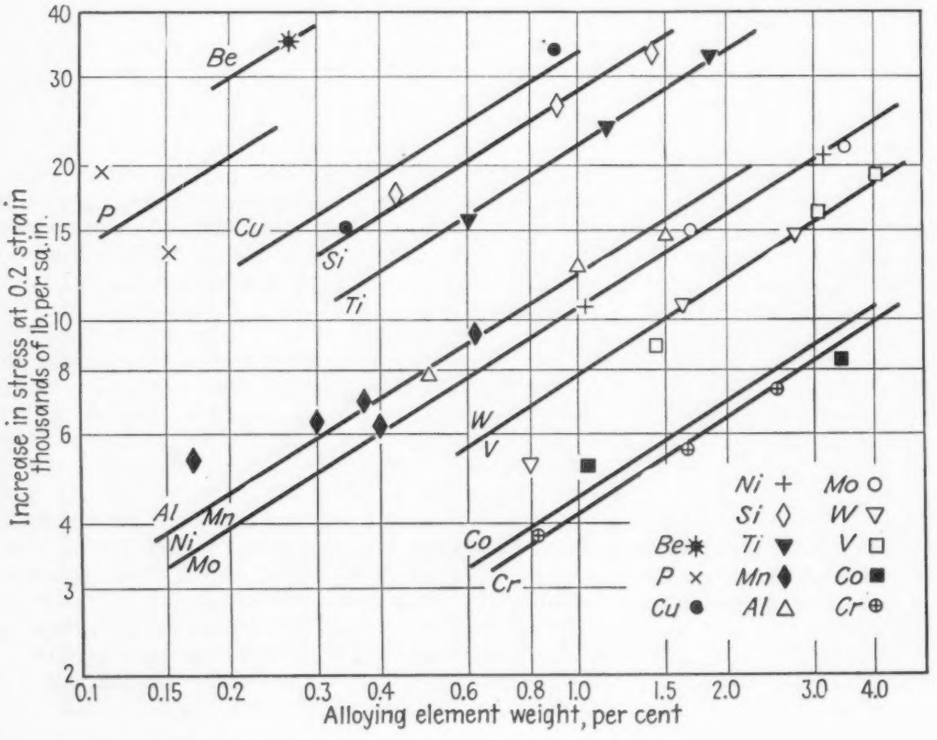


FIG. 2—Effects of alloying elements dissolved in carbon-free ferrite.

experimental points, the only reliable ones of which center, for steel, around $\delta=0.2$. Generally, only points have been used from $\delta=0.1$ to $\delta=0.3$, sometimes going a little lower than $\delta=0.1$. Below $\delta=0.1$, the points are quite reliable *if* the specimen is aligned very carefully before starting the test, *and* if a correction is made for the elastic strain. But above $\delta=0.3$, necking introduces uncertainties. Extrapolation from $\delta=0.3$ to $\delta=1.0$ can get you into trouble. On the other hand, the stress at $\delta=0.2$ is extremely reliable, and independent of the slope n of the line drawn through the points. The equation for the curve can just as well be written log σ—log $\sigma 0.2$=n (log δ—log 0.2), which is $\sigma=\sigma 0.2\ (\delta/0.2)^n$.

Observe that the stress at the maximum load, which would be the tensile strength if the original area had been used instead of the actual area, is a point of no particular significance, for it does not come as a particular value of strain. The stress at $\delta=0.2$ is the stress at the strain which is about average for the strain at maximum load, in iron about 20 pct, but varying from 10 to 30 pct. The author calls this stress at 0.2 strain the flow strength, in the same way that the stress at a strain of 0.2 pct or 0.002, has been called the yield strength; 20 pct strain, flow strength, 0.2 pct strain, yield strength.

n Must Be Determined

Enough for the methods of analyzing the data. What has been learned about strength and composition, and strength and structure? In the first place, for all the steels tested, and only steels have been worked with there is a fairly definite relationship between the flow strength and the strain-hardening exponent. This is shown in fig. 1. The data are for decarburized alloys of iron containing from very little to almost the limit of solubility of many alloying elements, and for steels containing carbon up to the eutectoid, in many structural conditions including those typical of quenching and tempering as well as direct austenite decomposition. The general relationship is apparent. Whether the scatter is experimental or real and a result of variations in the alloys remains to be seen. It seems likely that variations of n may be expected at a given strength level. If n were *really* a single-valued function of the flow stress it would simplify *wonderfully* the task of discussing the effect of alloying elements and dispersoids on the flow strength of iron. It would be necessary to report only the effects of those variables on the stress at a particular strain. The whole shape of the stress-strain curve would thereby be established, through this relationship between flow strength and the strain hardening exponent. But the writer is afraid that this is true only as a first approximation, and that it must be determined.

When the data summarized here was first reported the usual true stress-strain curve was used, uncorrected beyond necking-down, and *not* the log-log plot. Dr. Lacy and the writer concluded that for alloyed ferrites, the slope of the usual curve increased with the intercept; whereas Mrs. Hartner (nee Pearsall) and Messrs. Smith, Low and Pellini and the writer concluded for the heat-treated carbon steels, especially the eutectoid, that the slope of the stress-strain curve was substantially constant, although not quite constant. These differences are now in part resolved. The variation is less at high strength levels, more at low. As a first approximation, all stress-strain curves for steel belong to the same family; as the strength level increases, the strain-hardening exponent and therefore the rate of strain hardening diminishes.

Now consider what has been determined relative to original objective. First, consider the effects of alloying elements dissolved in carbon-free ferrite. The recalculated data are compiled in fig. 2. Some previously unreported results are here included with Dr. Lacy's. Mr. Frank Garofalo has provided some data on the effects of copper and phosphorus, notable omissions from Dr. Lacy's series. The copper and phosphorous-bearing steels contained appreciable concentrations of other alloying elements, necessitating the use of a method of successive approximations, starting with correlations based on Dr. Lacy's results. All of Lacy's and Garofalo's data were then reworked by Mrs. Hartner, improving the approximation until further corrections caused changes of the order of the fluctuations of the experimental results. The data

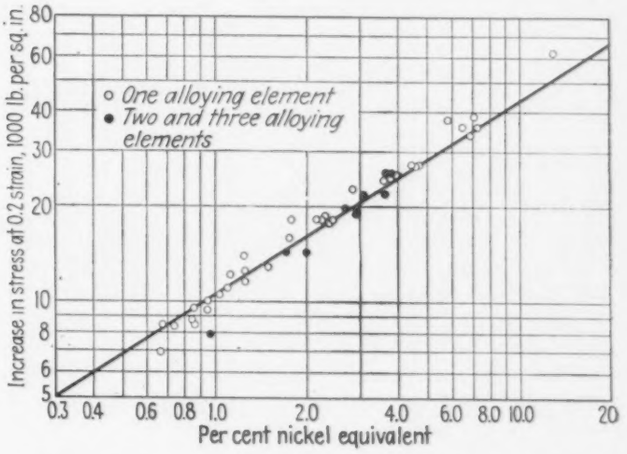


FIG. 3—The nickel line here has been taken from Fig. 2. The base strength for unalloyed ferrite has been taken as 30,000 psi.

as now plotted are thought to be free of error caused by residual alloying elements.

The writer should like to call attention to the courage displayed in drawing the line through the two points for phosphorus; most investigations would have drawn a line of quite different slope, in fact negative rather than positive. But the experimenters have the courage of their convictions. They refuse to believe that the way to soften steel is to add phosphorus. A straight line of a given slope through a single point, as for berrilium, is also a good trick. And maybe all the copper in this high-copper alloy is not in solution, or the solution is supersaturated; if so, copper is not as effective as is thought. There are still some things to do.

It has been found that the effects of dissolved alloying elements are additive in a simple way. To calculate the strength to be expected in alloys containing two or more alloying elements, from data obtained with simple binary alloys, the concept of equivalent nickel concentration has been used. Nickel is soluble over a wide range of concentrations and has a moderate effect on strength. To obtain the nickel equivalent of another element, simply observe from this

diagram what concentrations of Ni will increase the strength the same amount as 1 pct of the alloying element in question. For example, 1 pct of chromium is equivalent to 0.22 pct of nickel. Then to express the concentrations of chromium in an alloy as the equivalent nickel concentration, multiply the amount present by 0.22, which would be 0.44 pct; the same result is obtained by reading across from the chromium line in fig. 3 to the nickel line; 0.44 pct nickel strengthens iron by the same amount as 2 pct chromium.

It is possible to make a pretty good estimate of the strength of ternary or higher alloys by adding the equivalent nickel concentrations of all the alloying elements present, and looking up the strength on the nickel line of fig. 2. The filled-in circles of fig. 3 fit the line about as well as do the points for the binary alloys. The line of fig. 3 is the nickel line from fig. 2. In both figures, the base strength for unalloyed ferrite has been taken as 30,000 psi.

The equivalent nickel concentration is the quantity thought most likely to be useful in efforts to understand why alloying elements have the effects they have. Of course, considerable effort has been made to find other properties of these elements that correlate well with their strengthening effect in iron. Solubility in iron correlates rather well. By solubility is meant the extent of the primary α solid solution field in the binary phase diagram. Some of the data are not too certain. But in general, the relationship is good. There is a correlation with lattice distortion, observed by several investigators. Efforts to correlate equivalent nickel concentration with ion or atom size do not give such a regular relationship, although there is a rough increase in strengthening effect with difference from iron in ion size.

Another kind of property, electrode potential, correlates pretty well. Electrode and ionization potentials measure the work required to remove an electron. Somebody may see in this kind of thing some possibility of quantitative calculation. The points that lie

. . . Drawability of Aluminum

LIGHT metal engineers attending the Metal Congress indicated considerable interest in a report of a very thorough investigation of the drawability of aluminum alloys at elevated temperatures made by D. M. Finch, S. Wilson and J. E. Dorn of the University of California, Berkeley, Cal. Mr. Dorn is project supervisor and associate professor, while Messrs. Finch and Wilson are respectively research engineer and engineer at the university.

The report, entitled "Drawability of Aluminum Alloys at Elevated Temperatures," was presented at a Monday session of the American Society for Metals and was divided into two parts. Part I dealt with cylindrical cups, while part two was concerned with boxes. The following is an abstract of part I.

Forming of aluminum sheet material into shells, vessels, boxes, and other articles possessing considerable depth is usually best accomplished through the use of the deep draw press provided the number of parts to be produced is sufficiently great to warrant the high die costs, the authors pointed out.

As metal undergoing a deep drawing operation is subjected to non-uniform action of combined stresses, the simple tension test and the bend test do not provide sufficiently complete data to permit an evaluation of drawability. Various cupping tests, such as the Erichsen, Olsen, Amsler, Avery, Jovignot, and others, have been devised in attempts to establish a simple standard procedure for rating the drawability of metals. No cupping test yet devised correlates accurately the deep drawing characteristics of metals; hence, this paper reports a test that attempts to reproduce as accurately as possible all conditions encountered in actual production operations.

The simplest deep drawing operation consists of the production of the cylindrical cup from a circular blank. To perform this operation, a subpress unit consisting of heated drawing die, heated or water-cooled punch, and a heated pneumatic holding pad was used, as shown schematically in fig. 1. The hold-down pad (B, fig. 1) serves to prevent wrinkling during drawing. The subpress was installed between the upper and the lower platens of a variable speed hydropress. Provision was also made to change the punch so that the punch radius could be varied.

The temperature of the die plate and hold-down pad was maintained at the desired setting by means of on-off controlling pyrometers. All data reported refers to a water-cooled punch, varying from 70° to 80° F, because preliminary investigations revealed that greater draws were obtained with a cold punch. A majority of the tests were carried out with an average speed of about 26 ipm.

The aluminum alloys tested for their deep drawing

TABLE I

Aluminum Alloys and Temperatures Investigated

Group*	Alloy	Die Temperatures Degrees Fahr. 70	300	350	400	450	700
1A	3S-O, 52S-O	X			X	X	X
1B	24S-O	X			X	X	X
2A	24S-T	X	X	X	X	X	
2B	61S-T, 24S-T86	X	X	X	X	X	
2B	R301-T, XB75S-T	X	X	X	X	X	

* Group Description: 1A—Annealed alloys which are not precipitation-hardenable. 1B—Annealed alloys which are precipitation-hardenable. 2A—Alloys which are solution heat treated and precipitation hardened at atmospheric temperature. 2B—Alloys which are solution heat treated and precipitation hardened at elevated temperatures.

farthest away from the curve that have been drawn are for aluminum and for titanium, both of which are trivalent whereas the other elements plotted are divalent in the cell reactions used.

For the elements near iron in atomic number, the strengthening effect varies fairly regularly with atomic number, excepting Mn.

In summarizing what has been determined on strength, and other analyses on ductility (not abstracted here—Ed.), it may be stated that:

(1) Strength is not sensitive to local variations in composition and structure.

(2) It depends in a very regular way on composition in solid solutions.

(3) It depends in a very regular way on the mean spacing between particles in aggregate structures, and not at all on the shape of the particles except as this affects the mean spacing.

(4) The effect of dissolved elements is insignificant in comparison to the strengthening effect of fine dispersions (hardly a new observation).

(5) Ductility on the other hand is much affected by local conditions.

(6) *But,* local ductility, unless very low, has little effect on energy absorption in a structure. The distribution of deformation is apt to be of more consequence.

(7) Efforts to improve energy absorption in structures by improving the local, limiting deformation at the point of breaking are liable to be disappointing.

(8) Improvement in deformation distribution by modification of the plastic properties of substances should be more profitable, when the intrinsic ductility is considerable.

(9) However, this should not be true at high strength levels, where intrinsic ductility is low enough to be a more important factor. It is still important to try to improve the limiting, local deformation prior to fracture in high-strength materials. Even though it be of less importance in more ductile alloys.

Alloys

• Abstracts of papers presented at technical sessions of the Metal Congress presented here cover drawability of aluminum alloys at elevated temperatures, use of tellurium corewashes, nondestructive examination of welds.

properties, and the temperature conditions under which they were tested, are listed in table I.

The significant measures of the drawability of metals are those that reveal the maximum successful draw that may be achieved in a single operation. Although standard measures of drawability have not yet been established, the three following measures have been adopted:

$$(1)\quad \text{Pct Draw} = \frac{(D_b - D_p) \times 100}{D_b}$$

D_b = blank diam.

D_p = punch diam

$$(2)\quad D = \frac{D_b}{D_p}$$

D = drawability

$$(3)\quad \text{Relative Height} = \frac{h}{\frac{1}{2} D_p}$$

h = final outside height of cup

The various measures of drawability are not exactly comparable inasmuch as the pct draw and the drawability are measures of the initial blank and punch diameters, whereas the relative height of the cup refers to a drawn cup in which the walls may have thinned in certain regions and thickened in others. For a constant pct draw, the relative height of a drawn cup may be altered by changing the hold-down load, clearance or any other factor which caused a change in the drawing force and thereby a variation in wall thickness.

One of the major factors in the deep drawing of aluminum alloys at elevated temperatures was lubrication. The best lubricant found thus far was a 600W steam cylinder oil modified with 1¼ lb of graphite per gal of oil, which limited the drawing temperature to about 700° F. Microstructure studies of the group 1A alloys revealed that no significant change in grain size occurred at temperatures up to 900° F; group 1B alloy 24S-O showed no significant increase in grain size at temperatures up to about 850° F (where this material was hot-short). Until a suitable lubricant for use at temperatures above 700° F can be found, however, the maximum drawing temperature for these alloys is limited. The alloys in groups 2A and 2B are limited in maximum drawing temperature by the metallurgical effects of elevated temperature on their properties.

All of the alloys which were investigated revealed substantial increases in deep drawing properties with increase in die temperature, as illustrated by fig. 2. Group 1A alloys, 3S-O and 52S-O, revealed that the highest drawability is achieved at the highest test temperature of 700° F. Although these alloys have approximately the same drawability at atmospheric

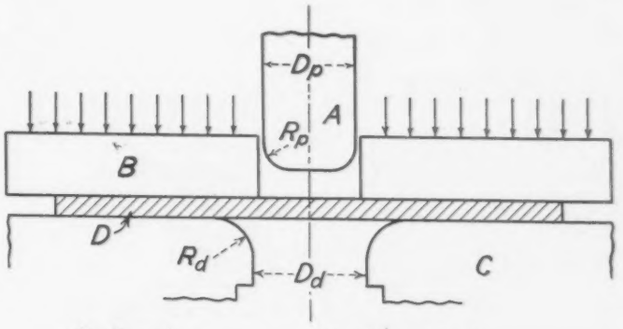


FIG 1—Essential parts of a deep draw press.

temperatures, 52S-O alloy exhibited superiority over 3S-O alloy at temperatures above about 500° F. Aluminum alloy 24S-O, the only example of group 1B alloys examined, shows only nominal improvement in its drawability up to about 400° F, but at higher temperatures deeper draws may be achieved. The drawability of 24S-O at 700° F is superior to that for 3S-O, but slightly below that for 52S-O.

The change in drawability of 24S-T, the only example of group 2A alloys investigated, is comparatively great for small changes in temperature between 70° and 400° F. It is noted that the deep drawing properties of 24S-T at 450° F are as good as the deep drawing properties of groups 1A and 1B alloys at

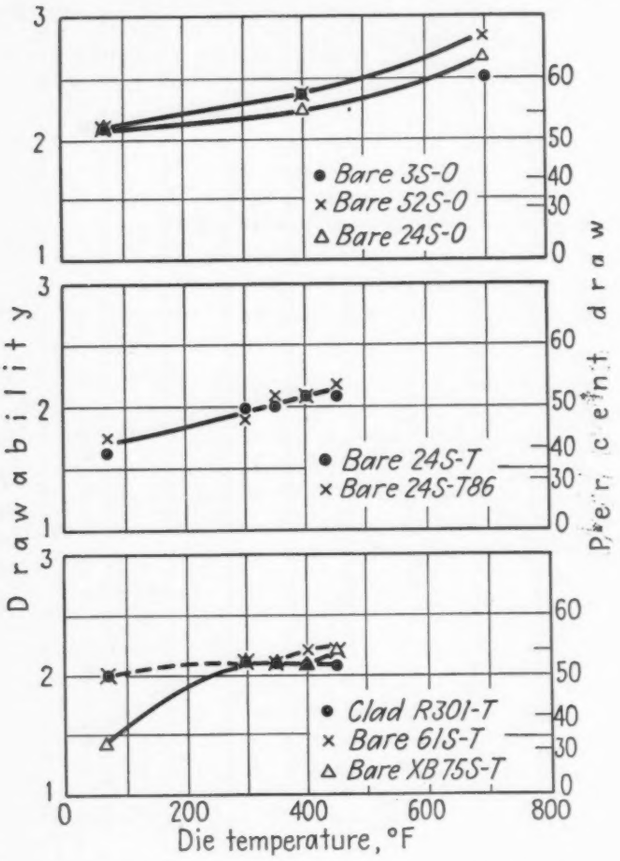


FIG. 2—Effect of die temperature on drawability of aluminum alloys.

70° F. This suggests the possibility of deep drawing 24S-T series alloys at 450° F for structural or semi-structural applications in lieu of deep drawing 24S-O at 70° F and then heat treating. By this technique the complications arising from warpage during heat treatment may be overcome and the production steps are simplified.

The general trends obtained for drawability of the high strength group 2B alloys are similar to those for group 1B. XB75S-T exhibited the poorest drawability of the group at 70° F, but so great was the improvement with increase in temperature that at 450° F it had a drawability equal to the greatest which was obtained for other alloys in this group. Alloy R301-T exhibited only slight improvement in drawability with increase in temperature. Comparison of the maximum height of cups produced from 24S-T86 and 24S-T shows that the former has better deep drawing properties than the latter. Conditions of drawing which yield major changes in thickness of the cup walls and conditions of sheet anisotropy which lead to the development of ears on the drawn cup preclude the possibility of interpreting the per cent draw or the drawability in terms of the useful dimensions of the finished product. This difficulty may be surmounted by reporting the deep drawing characteristics in terms of the relative height of the cup.

The effect of clearance* on drawability is not very

*Clearance is defined as:

$$\text{pct clearance} = \frac{D_d - (d_p - 2t)}{2t} \times 100$$

where, D_d = die diam, D_p = punch diam, and t = original thickness of sheet

marked, although 52S-O, XB75S-T and R301-T gave greater draws for dies with 4 pct clearance than for dies with 83 pct clearance (at 450° F), while 24S-T, 24S-T86 and 61S-T showed no change over this range.

Deep Drawing Boxes

In part II of the report, the authors pointed out that the investigation was conducted to determine whether the improvement in deep drawing at elevated temperature for cylindrical cups applied also to box-type parts. The equipment used was essentially the same as that used for the cylindrical cups, except that for this investigation, interchangeable die inserts and punches for a series of six corner die radii ranging from 1/16 to 1½ in. (round die) and for variable corner clearance using 1/16 and ⅜-in. corner die radii, were used. The corner clearance is defined as the distance between the corner wall of the punch and land of the die minus the sheet thickness measured along a line bisecting the corner angle.

The alloys investigated were as follows:

Group	Alloy
1A	none
1B	24S-O, 75S-O, XB75S-O
2A	24S-T
2B	24S-T81, 24S-T86, 75S-T, XB75S-T

In order to reduce the number of tests, the forming temperatures studied were limited to atmospheric temperature and 450° F. Although higher forming temperatures can be used for deep drawing the group I alloys, 450° F was selected inasmuch as the general aging characteristics of the group II alloys preclude the use of higher temperatures.

The significant measures of the drawability considered are (1) the h/d ratio, where h is the maximum trimmed height of the box and d is the inside width of the box (width of punch) and (2) per cent draw defined by:

$$\text{Pct Draw} = \frac{(D_b - d)}{D_b} \times 100$$

where D_b = blank diam. The maximum h/d ratio presents a measure of the maximum final height of

box for a given set of drawing conditions. whereas the per cent draw gives a measure of the maximum blank size that can be drawn for the same conditions. Generally the height of cup is a more informative measure for design and production use, although both are required if an actual part is to be formed, since a size of blank must be selected that can be drawn to the desired height.

Improved drawability at 450° F over drawability at 70° F was obtained for all the alloys tested. Further, at 450° F, all of the T-temper alloys tested permitted maximum draws equal to or greater than the maximum draws obtainable from 24S-O alloy at 70° F. The maximum drawabilities of the T-temper alloys tested, arranged according to decreasing drawability, are in the order of XB75S-T, 24S-T86, 24S-T81 and 24S-T.

The O-temper alloys tested, XB75S-O and 24S-O, gave a very large increase in drawability at 450° F over that obtained at 70° F.

The improvement in drawability at 450° F as compared to 70° F was the greatest for the high strength alloys. The results warrant consideration of deep drawing in the hardened temper at elevated temperatures rather than deep drawing in the annealed condition at atmospheric temperature and subsequently heat treating and aging.

Several developed blanks were investigated in an effort to increase the maximum per cent draw and height of box producing a box without ears. A slight increase in height of box was obtained by removing a small amount of material from the area from which the ears formed, but when sufficient material was removed to produce a box without ears, severe wrinkles were formed along the corners. In general, a circular blank shape was the most satisfactory for producing square box-type parts.

Effect of Tellurium Corewashes on Shrink Defects

Use of tellurium base corewashes as a solution for some troublesome gray iron foundry problems, particularly shrinks, was suggested in a paper by J. O. Vadeboncoeur, research metallurgist, Pontiac Motor Div., General Motors Corp., Pontiac, Mich., presented at a Tuesday ASM session.

The report, entitled "Tellurium Corewashes," pointed out that use of tellurium as an alloying agent in gray iron foundries has been somewhat limited, but is finding increased popularity as a means of selective control of casting structure. This control was said to be most easily achieved through the use of cores dipped or painted with washes containing the suspended metal.

The author reported that by painting a 1-in. stripe of tellurium corewash on the core at the oil galley line where the stud bolts enter, a bad shrink on diesel cylinder blocks had been eliminated. Another shrink on a stud bolt boss on the water jacket of a truck cylinder block was eliminated by a spot of tellurium corewash. The successful mass production of diesel cylinder liners in a horizontal position was said to have been made possible by dipping the liner cores in a tellurium wash.

These liner cores were dipped in a shallow tank immediately after removal from the core oven. A rod was placed through a vent hole which passed through the longitudinal axis of the cylindrical core. The core was revolved about the rod while immersed in the tank. An evenly applied coating was thus obtained which dried rather rapidly. It was found that best results were obtained when the specific gravity of the wash was held to 33° Be.

TABLE I

	Pct
SiO_2	65-68
Fe_2O_3	2
Al_2O_3	6
Te	23-25
Se	trace
Ta	trace

The laboratory analysis of the tellurium corewash paste, carrying about 20 pct moisture, in successful use for producing a local chilled area on several different castings is shown in Table I.

The author stressed that in the original paste form the material is far too potent to be handled by production personnel. To overcome this the washes were mixed under laboratory supervision. One of the mixtures which met with particular success in production work consisted of 750 g (1.65 lb) of the original paste to five liters (5.28 qt) of water. One volume of this in turn is mixed with five volumes of No. 798 Plumbago wash at 27° Be. Another mixture developed for its property of suspension consists of 10 pct tellurium paste, 5 pct bentonite, 5 pct silica flour and 80 pct water. One volume of this mixture is added to four volumes of 798 Plumbago wash at 27° Be. The resulting mixture holds quite well in suspension.

Care in application was urged in the paper, for if the wash is misplaced or too generously applied, the resulting chill might easily be cause for scrapping the casting. Migration of the chilled portions may also occur.

Mr. Vadeboncoeur suggested two possible methods by which the tellurium from the corewash was introduced into the iron; elemental atoms of tellurium may diffuse into the iron, or the diffusion of the vapors themselves may be instrumental in uniting the two metals. Conclusive evidence is lacking, the author pointed out, for either argument, but after observing the gases associated with every experiment conducted on this metal, he was inclined to favor the vapor diffusion hypothesis.

In either event, he said, once the tellurium becomes incorporated as an alloying agent within the iron, the carbides are completely stabilized for a uniform depth on the surface of the casting. The

depth of the chilled area depends only upon the amount of tellurium present in the wash and can be varied to suit the requirements of the job.

Tellurium corewashes appear to be particularly effective in preventing shrinks. The hypothesis advanced by some foundrymen to explain this property is that the viscosity of the metal is raised at the mold-metal interface. It is equally probable, the author stressed, that the diffusion of tellurium increases the crystallization velocity of the melt and thus causes it to solidify more quickly under the same molding conditions.

Lester Lecturer Stresses Nondestructive Tests

HIGHLIGHT of the fifth annual meeting of the American Industrial Radium and X-ray Society, held in conjunction with the Metal Congress, was the presentation of the Second Lester Lecture by O. R. Carpenter of Babcock & Wilcox Co., on Wednesday.

The speaker was introduced by Dr. Lester, who paid high tribute to both Mr. Carpenter and his company, for the outstanding work done by them in making radiography an important and practical industrial tool.

In announcing the title of his talk, "Advances in Steel Weldments in the Past Few Years," Mr. Carpenter stated that this was somewhat of a misnomer, since he intended to concentrate chiefly on the application of the various nondestructive tests for examination of weld soundness, which had been instrumental in making possible high quality welds in pressure vessels of heavy wall thickness.

Tracing the development of these tests from the early hammer and stethoscope, through the magnetic types, and the Sperry supersonic units, he showed how Dr. Lester's work with radiographs had proved so successful as to lead to the establishing of standards of acceptability by radiographs. He described the operation of the Sperry supersonic reflectoscope and by means of lantern slides demonstrated how indications shown on this instrument could locate interior flaws in either weld or parent metal, proving this by micrographs taken through the same sections. He emphasized, however, that there was still considerable work to be done and experience to be gained by experimental use of the instrument, before it could be applied successfully to light sections.

At the conclusion of the lecture Mr. Carpenter was presented with the Lester medal in appreciation of his outstanding work.

Graphitization in Hypo-Eutectoid Steels

A REPORT on susceptibility of hypo-eutectiod Steel to graphitization when cold rolled and annealed at subcritical temperatures was contained in a paper presented at an ASM session by M. A. Hughes and J. G. Cutton, Carnegie-Illinois Steel Corp.

In the past two or three years there has been a material increase in the requirements for cold rolled annealed carbon steel strip. In the processing of such material little or no consideration has been given to the possibilities of graphite formation in the annealing operation subsequent to cold rolling, the paper pointed out. It has been found, however, that under certain conditions graphite may be formed in cold rolled annealed hypo-eutectoid carbon strip and, once formed, may be eliminated by subsequent thermal decreased the probability of graphite formation. Annealing times longer than those generally employed in commercial annealing were required to graphitize the cold rolled strip, and chromium was found to stabilize the carbides, while copper appeared to have no effect upon the stability of the carbides.

When cold rolled strip samples were subjected to two cold reductions totaling 50 pct reduction, and two subcritical anneals totaling 144 hr at 1200° F, it was observed that first reductions of 10 pct, 20 pct and 30 pct produced more graphite than 0 pct, 40 pct and 50 pct first reductions.

Hot rolled strip, made by a coarse grain deoxidation practice, did not graphitize when subjected to cold rolling and annealing procedures which readily pro-

New Lathe for Small Turning Work

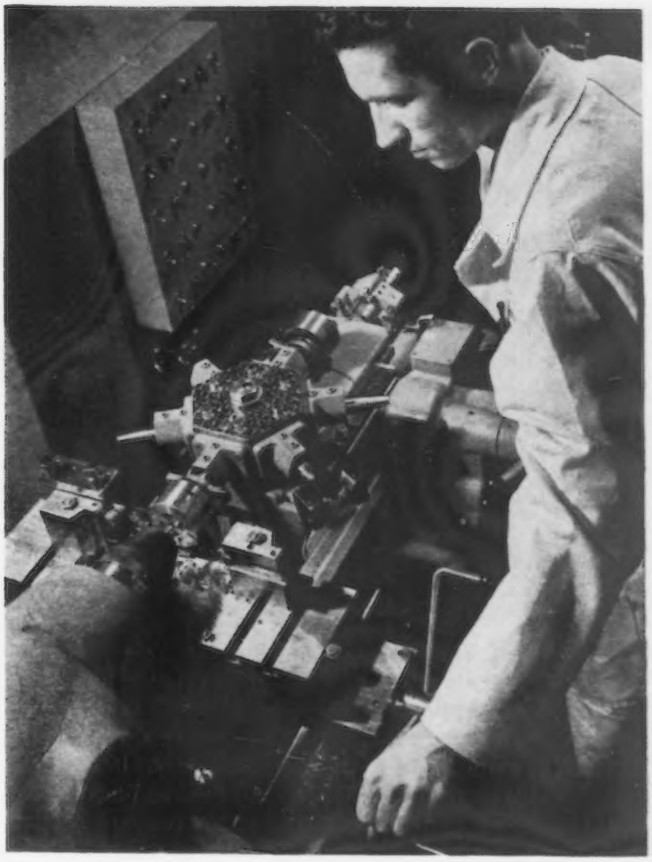


FIG. 1—The new Speed-Matic manufacturing lathe introduced by Monarch for high-production work. It features a precision turret with 12 feeds, and automatic speed changes for each turret position.

DESIGNED to handle small turning work in quantities of from 25 to 500 or more pieces with ease and quickness of setup, a new high production, hand screw machine has been announced by the Monarch Machine Tool Co., Sidney, Ohio. Equipped with power feed ram type turret, hand operated cutoff slide, and preselected changeable spindle speeds ranging from 50 rpm to 5000 rpm, it is said to be one of the highest production units of its kind in the field.

The power feed turret has built into it an additional six feeds to the turret slide which, combined with the high and low feed of the main gear box, gives a range of 12 feeds. These range from 0.0005 in. per rev to 0.016 in. per rev. The turret slide is manually operated by capstan handwheel and is

position by means of a spring and helical rack mechanism, without the aid of the operator.

A motor-generator set is used for converting ac to dc for the machine drive and controls. The relay panel for the machine houses the potentiometers and other electrical equipment necessary for automatically changing spindle speeds to conform to the requirements of the tool for that particular operation. Spindle speeds for each face of the turret, as well as the cutoff slide, are preselected to their proper position by means of these potentiometers.

Whenever the turret indexes, as application is made of all tools, it comes back against a finger which automatically changes the speed for the next operation by controlling the circuit through the potentiometers. The ten-station panel has six stations for the six sides of the turret, two stations for the

certain conditions graphite may be formed in cold rolled annealed hypo-eutectoid carbon strip and, once formed, may be eliminated by subsequent thermal

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MAXWELL GENSAMER

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By MAXWELL GENSAMER

Head, Department of Mineral Technology, Pennsylvania State College

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IN this, the twentieth Campbell Memorial lecture, attention will be concentrated on the problem of trying to understand *quantitatively* how alloying elements in solid solution, and undissolved compounds distributed in these solid solutions, affect mechanical properties.

Broadly, there are two aspects to what is meant by mechanical properties. These are succinctly called strength and ductility. By strength is meant the resistance of a substance to distortion or fracture, and by ductility is meant how much it may distort before fracture. There are many ways to measure these. The author chooses to concentrate on the simple tension test, for it is believed to yield as much or more information than any other test. Indentation hardness, which has been widely used, yields much less information, and those who have used it *only* have missed much of interest. Even the tension test alone is inadequate to complete understanding, but by and large other tests are useful to supplement what the tension test can tell. This applies particularly to measurements of strength, for which the tension test is almost wholly adequate; but it does not apply so well to ductility, where the conditions of loading are much more important and much less well understood in their action.

There are two aspects to what is meant by strength. These are, first, resistance to flow, and second, resistance to fracture. Both are functions of numerous variables, and can only be plotted on two-dimensional space by ignoring or holding constant all the variables but one. Both must be thought of as surfaces in multidimensional space. Among the variables which may influence both the flow and fracture stress, aside from composition and structure which are of principal concern in this paper, it should be noted that strain, time rate of straining, and temperature are the ones that most commonly are taken into consideration. If the resistance to flow and the resistance to fracture are plotted against strain, the two curves may be referred to simply as the flow curve and the fracture curve, for the effect of deformation on strength is most familiar. Then the effect of the other variables is to shift these curves.

What is meant by stress and by strain in plots like this needs discussion. The state of stress at a point requires for its description, ignoring the *orientation* of the element of volume of the material under discussion, that the values of the *three* principal stresses be given. Only if a *function* can be found of the three principal stresses, by *experiment* invariable among the three principal stresses, is it possible to plot a single quantity and call it the resistance to flow (or fracture) without reference to the particular values of the three principal stresses. Unless this principal stress invariant can be found, the ratio of the other two principal stresses to the one plotted as the resistance must be considered among the variables. And so with strain. As a first approximation, the von-Mises criterion for flow, sometimes called the shear-strain-energy, comes pretty close to providing this stress invariant for flow; but it is not exact, depending at least on the average value of the three principal stresses. And as to the fracture strength, even an approximate stress invariant still has not been found.

There are many experimental difficulties in the way of finding a principal stress invariant for fracture, or for that matter measuring the fracture strength for any but special values of the variables affecting it. The principal stresses at fracture are usually unknown because of "necking down," which precedes fracture in most circumstances for ductile metals. When the material is relatively brittle, so that fracture precedes necking down, it is not too difficult to obtain a particular point on the fracture curve; it is that point where the fracture curve crosses the flow curve, which is when the metal breaks. Up to that time the metal is flowing because the resistance to fracture is less than the resistance to flow. And up until that time it is not possible to know where the fracture curve lies.

So, without changing any of the other variables,

with the high and low feed of the main gear box, gives a range of 12 feeds. These range from 0.0005 in. per rev to 0.016 in. per rev. The turret slide is manually operated by capstan handwheel and is

which automatically changes the speed for the next operation by controlling the circuit through the potentiometers. The ten-station panel has six stations for the six sides of the turret, two stations for the

Abstract—Twentieth Campbell Memorial Lecture

as yet has found out how to determine the course of the fracture curve, for the general case when both flow and fracture are affected by all the variables at their disposal. If a variable could be found that would affect the flow curve but *not* affect the fracture curve, then by changing *that* variable it is possible to proceed along a series of flow curves to the breaking point on a *single* fracture curve, and so get enough points to plot it. It has been suggested that temperature is such a variable, and that changing the temperature shifts the flow curve but not the fracture curve. The author is afraid this is a vain hope, although it is true that the flow stress is affected more by changing the temperature than is the fracture stress.

High Speed Tensile Tests

Zener and Hollomon have made a pretty good case for a single-valued functional relationship between speed of testing and temperature. If such an equivalence is borne out by more experience, then changing the speed of testing should be equivalent to changing the temperature, and tests carried out at different speeds should result in fracture at different limiting strains, that is, ductility should vary with the speed of testing, the way it does with temperature. Unfortunately, some of the author's experience with high-speed testing in simple tension does not confirm this; high-speed tensile tests on steel result in the same tensile reduction of area as slow speed tests. Either speed and temperature are *not* equivalent, or what is more likely, resistance to flow and resistance to fracture are both affected, and in such a way as to yield the same deformation at fracture. *But* then, such high-speed tests are open to questions of interpretation. Because of the limited speed of propagation of a plastic wave, it may be that the actual rate of deformation at the instant of fracture is independent of the speed with which the cross-heads of the testing machine are moving apart, or at least it may be that even very fast rates of testing fail to achieve a high rate of unit deformation at the point of fracture. Here is one of the important and annoying complexities encountered in high-speed testing.

It is then necessary generally to ignore the fracture curve and to discuss the subject in terms of the flow-curve and either the deformation or stress at fracture, which is unfortunate because it cannot give the whole story. But, to do the best that can be done, consider first the flow curve, then ductility.

The discussion of the effects of composition and structure on the flow strength of metals is to be based on the stress-strain curve obtained in tension. The

the methods used to analyze tension test data, methods which make the wide applicability of the tension test more apparent, and which have led to simplification of the relationships between composition or structure and the tensile properties. For a typical iron alloy, data may be plotted in several ways, stress against strain or load against strain. And a plot may be made of the logarithm of the stress against the logarithm of the strain. It is the writer's experience that, over the whole of the stress-strain curve *in which confidence is possible*, the curve is always a straight line when plotted logarithmically. Beyond the point where necking down begins, there are departures from the straight-line plot for which quantitative corrections can not be made; these departures result from the circumstance that there is no longer simple tension after necking down begins, from the increase in speed of deformation when it is localized by this necking down, and possibly from some reorientation effects. It is only fair to assume that the curve would be straight to the point of fracture *if* these disturbances could be avoided.

Effect of Necking-Down

It is of interest to follow the plotting of a point on the final logarithmic curve, all the way from the original data to the final straight-line plot. Necking down begins at the maximum load (or maximum in load divided by original area, which is what is plotted here). If it were not for necking down, it would be possible to go from a load or *nominal* stress versus extension curve to a load versus reduction-of-area curve by calculation. Up to the time of necking-down the one curve can be calculated from the other, by using the fact that the volume or density of a metal is unchanged by plastic deformation, requiring constancy of the product of length by area. But after necking-down, this calculation is not possible, for the overall extension depends on the distribution of deformation.

To get a true stress-strain curve it is necessary to have the area, which must be measured after necking-down begins. For each point then the diameter must be measured, at the point where it is least, at the center of the necked-down region. From the area we may calculate the strain, using always the logarithmic strain when the strains are large. The logarithmic strain takes into account the fact that the gage length is changing throughout the test, and it may be regarded as the true strain; it is simply the integral of dl/l, instead of $\Delta l/l_o$, the conventional strain.

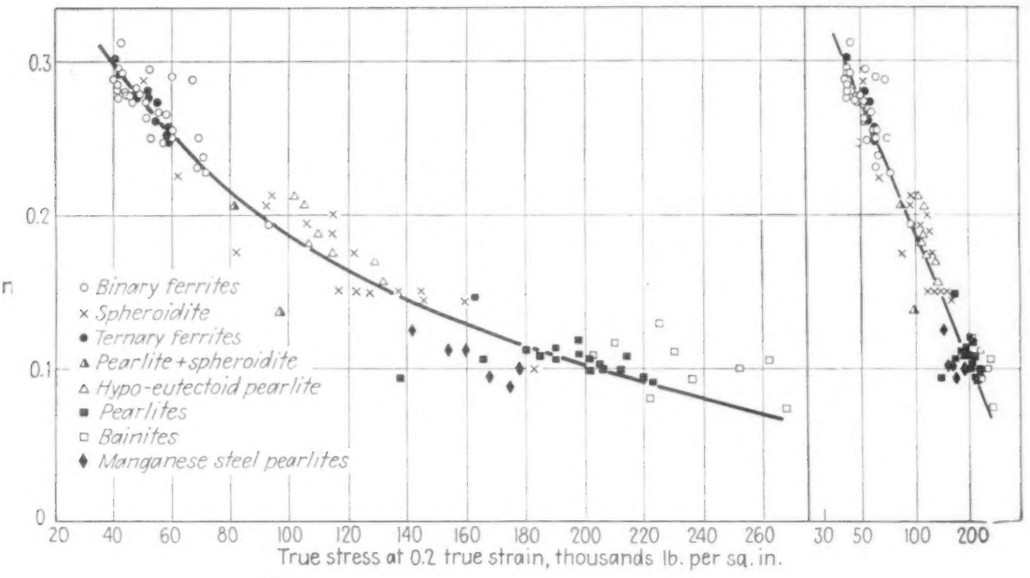


FIG. 1—There is a fairly definite relationship between the flow strength and the strain hardening exponent.

Dividing the load by the actual area gives the apparent true stress. This, however, is in need of correction because there are lateral tensile stresses in the necked-down region, which lead to higher average stress than would be the case if simple tension prevailed; and, unless the test is run very slowly, the rate of straining may be high. Bridgman has attempted to calculate the correction required by the presence of lateral tensile stresses, but his correction is in the writer's experience not quite enough; the corrected points still lie a little above the straight line in the log-log plot of stress versus true or logarithmic strain.

The fact that the log-log plot is a straight line means that all these tensile curves are general parabolas, fitting equations of the form $\sigma = \sigma_1 \delta^N$, where σ is the true stress, σ_1 is the true stress at unit strain ($\zeta = 1.0$), ζ is the true strain ($\ln l/l_0$), and n which may be called the strain-hardening exponent; it is the slope of the log-log plot. It is interesting to note that the rate of strain hardening, $d\sigma/d\delta$, obtained by differentiation of this equation, is equal to $6/\delta n$, that is, the ratio of the stress to the strain multiplied by n; the greater n, the greater the rate of strain hardening. The constants which describe *completely* the whole course of the corrected stress-strain curve are then σ_1 and n.

The writer has chosen to discuss, not σ_1, but the stress for a strain of 0.2, which we have called $\sigma 0.2$. The reason for this is that the σ_1 value is influenced much more by how the line is drawn through the

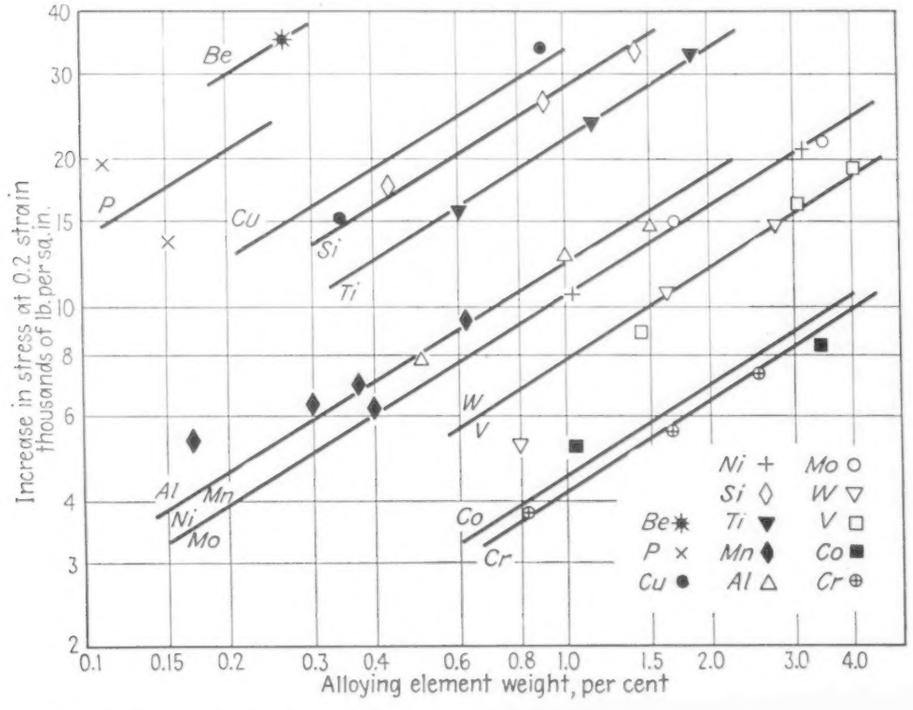


FIG. 2—Effects of alloying elements dissolved in carbon-free ferrite.

experimental points, the only reliable ones of which center, for steel, around $\delta=0.2$. Generally, only points have been used from $\delta=0.1$ to $\delta=0.3$, sometimes going a little lower than $\delta=0.1$. Below $\delta=0.1$, the points are quite reliable *if* the specimen is aligned very carefully before starting the test, *and* if a correction is made for the elastic strain. But above $\delta=0.3$, necking introduces uncertainties. Extrapolation from $\delta=0.3$ to $\delta=1.0$ can get you into trouble. On the other hand, the stress at $\delta=0.2$ is extremely reliable, and independent of the slope n of the line drawn through the points. The equation for the curve can just as well be written $\log \sigma - \log \sigma 0.2 = n (\log \delta - \log 0.2)$, which is $\sigma = \sigma 0.2 (\delta/0.2)^n$.

Observe that the stress at the maximum load, which would be the tensile strength if the original area had been used instead of the actual area, is a point of no particular significance, for it does not come as a particular value of strain. The stress at $\delta=0.2$ is the stress at the strain which is about average for the strain at maximum load, in iron about 20 pct. but varying from 10 to 30 pct. The author calls this stress at 0.2 strain the flow strength, in the same way that the stress at a strain of 0.2 pct or 0.002, has been called the yield strength; 20 pct strain, flow strength, 0.2 pct strain, yield strength.

n Must Be Determined

Enough for the methods of analyzing the data. What has been learned about strength and composition, and strength and structure? In the first place, for all the steels tested, and only steels have been worked with there is a fairly definite relationship between the flow strength and the strain-hardening exponent. This is shown in fig. 1. The data are for decarburized alloys of iron containing from very little to almost the limit of solubility of many alloying elements, and for steels containing carbon up to the eutectoid, in many structural conditions including those typical of quenching and tempering as well as direct austenite decomposition. The general relationship is apparent. Whether the scatter is experimental or real and a result of variations in the alloys remains to be seen. It seems likely that variations of n may be expected at a given strength level. If n were *really* a single-valued function of the flow stress it would simplify *wonderfully* the task of discussing the effect of alloying elements and dispersoids on the flow strength of iron. It would be necessary to report only the effects of those variables on the stress at a particular strain. The whole shape of the stress-strain curve would thereby be established, through this relationship between flow strength and the strain hardening exponent. But the writer is afraid that this is true only as a first approximation, and that it must be determined.

When the data summarized here was first reported the usual true stress-strain curve was used, uncorrected beyond necking-down, and *not* the log-log plot. Dr. Lacy and the writer concluded that for alloyed ferrites, the slope of the usual curve increased with the intercept; whereas Mrs. Hartner (nee Pearsall) and Messrs. Smith, Low and Pellini and the writer concluded for the heat-treated carbon steels, especially the eutectoid, that the slope of the stress-strain curve was substantially constant, although not quite constant. These differences are now in part resolved. The variation is less at high strength levels, more at low. As a first approximation, all stress-strain curves for steel belong to the same family; as the strength level increases, the strain-hardening exponent and therefore the rate of strain hardening diminishes.

Now consider what has been determined relative to original objective. First, consider the effects of alloying elements dissolved in carbon-free ferrite. The recalculated data are compiled in fig. 2. Some previously unreported results are here included with Dr. Lacy's. Mr. Frank Garofalo has provided some data on the effects of copper and phosphorus, notable omissions from Dr. Lacy's series. The copper and phosphorous-bearing steels contained appreciable concentrations of other alloying elements, necessitating the use of a method of successive approximations, starting with correlations based on Dr. Lacy's results. All of Lacy's and Garofalo's data were then reworked by Mrs. Hartner, improving the approximation until further corrections caused changes of the order of the fluctuations of the experimental results. The data

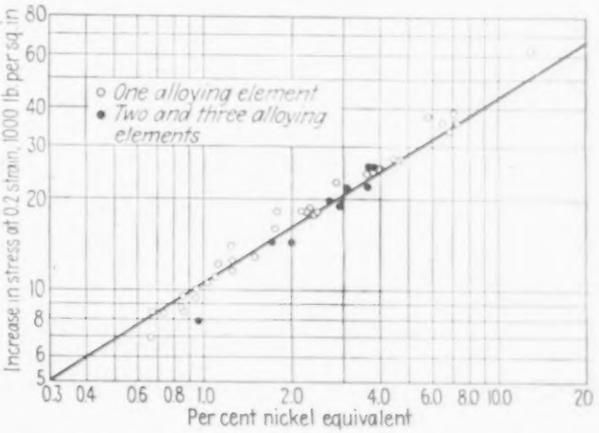


FIG. 3—The nickel line here has been taken from Fig. 2. The base strength for unalloyed ferrite has been taken as 30,000 psi.

as now plotted are thought to be free of error caused by residual alloying elements.

The writer should like to call attention to the courage displayed in drawing the line through the two points for phosphorus; most investigations would have drawn a line of quite different slope, in fact negative rather than positive. But the experimenters have the courage of their convictions. They refuse to believe that the way to soften steel is to add phosphorus. A straight line of a given slope through a single point, as for berrilium, is also a good trick. And maybe all the copper in this high-copper alloy is not in solution, or the solution is supersaturated; if so, copper is not as effective as is thought. There are still some things to do.

It has been found that the effects of dissolved alloying elements are additive in a simple way. To calculate the strength to be expected in alloys containing two or more alloying elements, from data obtained with simple binary alloys, the concept of equivalent nickel concentration has been used. Nickel is soluble over a wide range of concentrations and has a moderate effect on strength. To obtain the nickel equivalent of another element, simply observe from this

diagram what concentrations of Ni will increase the strength the same amount as 1 pct of the alloying element in question. For example, 1 pct of chromium is equivalent to 0.22 pct of nickel. Then to express the concentrations of chromium in an alloy as the equivalent nickel concentration, multiply the amount present by 0.22, which would be 0.44 pct; the same result is obtained by reading across from the chromium line in fig. 3 to the nickel line; 0.44 pct nickel strengthens iron by the same amount as 2 pct chromium.

It is possible to make a pretty good estimate of the strength of ternary or higher alloys by adding the equivalent nickel concentrations of all the alloying elements present, and looking up the strength on the nickel line of fig. 2. The filled-in circles of fig. 3 fit the line about as well as do the points for the binary alloys. The line of fig. 3 is the nickel line from fig. 2. In both figures, the base strength for unalloyed ferrite has been taken as 30,000 psi.

The equivalent nickel concentration is the quantity thought most likely to be useful in efforts to understand why alloying elements have the effects they have. Of course, considerable effort has been made to find other properties of these elements that correlate well with their strengthening effect in iron. Solubility in iron correlates rather well. By solubility is meant the extent of the primary α solid solution field in the binary phase diagram. Some of the data are not too certain. But in general, the relationship is good. There is a correlation with lattice distortion, observed by several investigators. Efforts to correlate equivalent nickel concentration with ion or atom size do not give such a regular relationship, although there is a rough increase in strengthening effect with difference from iron in ion size.

Another kind of property, electrode potential, correlates pretty well. Electrode and ionization potentials measure the work required to remove an electron. Somebody may see in this kind of thing some possibility of quantitative calculation. The points that lie

. . . Drawability of Aluminum

LIGHT metal engineers attending the Metal Congress indicated considerable interest in a report of a very thorough investigation of the drawability of aluminum alloys at elevated temperatures made by D. M. Finch, S. Wilson and J. E. Dorn of the University of California, Berkeley, Cal. Mr. Dorn is project supervisor and associate professor, while Messrs. Finch and Wilson are respectively research engineer and engineer at the university.

The report, entitled "Drawability of Aluminum Alloys at Elevated Temperatures," was presented at a Monday session of the American Society for Metals and was divided into two parts. Part I dealt with cylindrical cups, while part two was concerned with boxes. The following is an abstract of part I.

Forming of aluminum sheet material into shells, vessels, boxes, and other articles possessing considerable depth is usually best accomplished through the use of the deep draw press provided the number of parts to be produced is sufficiently great to warrant the high die costs, the authors pointed out.

As metal undergoing a deep drawing operation is subjected to non-uniform action of combined stresses, the simple tension test and the bend test do not provide sufficiently complete data to permit an evaluation of drawability. Various cupping tests, such as the Erichsen, Olsen, Amsler, Avery, Jovignot, and others, have been devised in attempts to establish a simple standard procedure for rating the drawability of metals. No cupping test yet devised correlates accurately the deep drawing characteristics of metals; hence, this paper reports a test that attempts to reproduce as accurately as possible all conditions encountered in actual production operations.

The simplest deep drawing operation consists of the production of the cylindrical cup from a circular blank. To perform this operation, a subpress unit consisting of heated drawing die, heated or water-cooled punch, and a heated pneumatic holding pad was used, as shown schematically in fig. 1. The hold-down pad (B, fig. 1) serves to prevent wrinkling during drawing. The subpress was installed between the upper and the lower platens of a variable speed hydropress. Provision was also made to change the punch so that the punch radius could be varied.

The temperature of the die plate and hold-down pad was maintained at the desired setting by means of on-off controlling pyrometers. All data reported refers to a water-cooled punch, varying from 70° to 80° F, because preliminary investigations revealed that greater draws were obtained with a cold punch. A majority of the tests were carried out with an average speed of about 26 ipm.

The aluminum alloys tested for their deep drawing

TABLE I

Aluminum Alloys and Temperatures Investigated

Group*	Alloy	Die Temperatures Degrees Fahr. 70	300	350	400	450	700
1A	3S-O, 52S-O	X			X	X	X
1B	24S-O	X			X	X	X
2A	24S-T	X	X	X	X	X	
2B	61S-T, 24S-T86	X	X	X	X	X	
2B	R301-T, XB75S-T	X	X	X	X	X	

* Group Description: 1A—Annealed alloys which are not precipitation-hardenable. 1B—Annealed alloys which are precipitation-hardenable. 2A—Alloys which are solution heat treated and precipitation hardened at atmospheric temperature. 2B—Alloys which are solution heat treated and precipitation hardened at elevated temperatures.

farthest away from the curve that have been drawn are for aluminum and for titanium, both of which are trivalent whereas the other elements plotted are divalent in the cell reactions used.

For the elements near iron in atomic number, the strengthening effect varies fairly regularly with atomic number, excepting Mn.

In summarizing what has been determined on strength, and other analyses on ductility (not abstracted here—Ed.), it may be stated that:

(1) Strength is not sensitive to local variations in composition and structure.

(2) It depends in a very regular way on composition in solid solutions.

(3) It depends in a very regular way on the mean spacing between particles in aggregate structures, and not at all on the shape of the particles except as this affects the mean spacing.

(4) The effect of dissolved elements is insignificant in comparison to the strengthening effect of fine dispersions (hardly a new observation).

(5) Ductility on the other hand is much affected by local conditions.

(6) *But*, local ductility, unless very low, has little effect on energy absorption in a structure. The distribution of deformation is apt to be of more consequence.

(7) Efforts to improve energy absorption in structures by improving the local, limiting deformation at the point of breaking are liable to be disappointing.

(8) Improvement in deformation distribution by modification of the plastic properties of substances should be more profitable, when the intrinsic ductility is considerable.

(9) However, this should not be true at high strength levels, where intrinsic ductility is low enough to be a more important factor. It is still important to try to improve the limiting, local deformation prior to fracture in high-strength materials. Even though it be of less importance in more ductile alloys.

Alloys

• Abstracts of papers presented at technical sessions of the Metal Congress presented here cover drawability of aluminum alloys at elevated temperatures, use of tellurium corewashes, nondestructive examination of welds.

properties, and the temperature conditions under which they were tested, are listed in table I.

The significant measures of the drawability of metals are those that reveal the maximum successful draw that may be achieved in a single operation. Although standard measures of drawability have not yet been established, the three following measures have been adopted:

(1) $$\text{Pct Draw} = \frac{(D_b - D_p) \times 100}{D_b}$$

D_b = blank diam.
D_p = punch diam

(2) $$D = \frac{D_b}{D_p}$$

D = drawability

(3) $$\text{Relative Height} = \frac{h}{\frac{1}{2} D_p}$$

h = final outside height of cup

The various measures of drawability are not exactly comparable inasmuch as the pct draw and the drawability are measures of the initial blank and punch diameters, whereas the relative height of the cup refers to a drawn cup in which the walls may have thinned in certain regions and thickened in others. For a constant pct draw, the relative height of a drawn cup may be altered by changing the hold-down load, clearance or any other factor which caused a change in the drawing force and thereby a variation in wall thickness.

One of the major factors in the deep drawing of aluminum alloys at elevated temperatures was lubrication. The best lubricant found thus far was a 600W steam cylinder oil modified with 1¼ lb of graphite per gal of oil, which limited the drawing temperature to about 700° F. Microstructure studies of the group 1A alloys revealed that no significant change in grain size occurred at temperatures up to 900° F; group 1B alloy 24S-O showed no significant increase in grain size at temperatures up to about 850° F (where this material was hot-short). Until a suitable lubricant for use at temperatures above 700° F can be found, however, the maximum drawing temperature for these alloys is limited. The alloys in groups 2A and 2B are limited in maximum drawing temperature by the metallurgical effects of elevated temperature on their properties.

All of the alloys which were investigated revealed substantial increases in deep drawing properties with increase in die temperature, as illustrated by fig. 2. Group 1A alloys, 3S-O and 52S-O, revealed that the highest drawability is achieved at the highest test temperature of 700° F. Although these alloys have approximately the same drawability at atmospheric

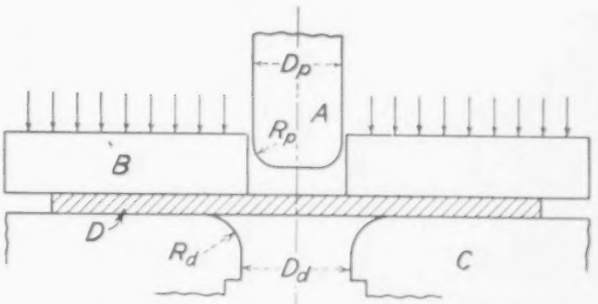


FIG 1—Essential parts of a deep draw press.

temperatures, 52S-O alloy exhibited superiority over 3S-O alloy at temperatures above about 500° F. Aluminum alloy 24S-O, the only example of group 1B alloys examined, shows only nominal improvement in its drawability up to about 400° F, but at higher temperatures deeper draws may be achieved. The drawability of 24S-O at 700° F is superior to that for 3S-O, but slightly below that for 52S-O.

The change in drawability of 24S-T, the only example of group 2A alloys investigated, is comparatively great for small changes in temperature between 70° and 400° F. It is noted that the deep drawing properties of 24S-T at 450° F are as good as the deep drawing properties of groups 1A and 1B alloys at

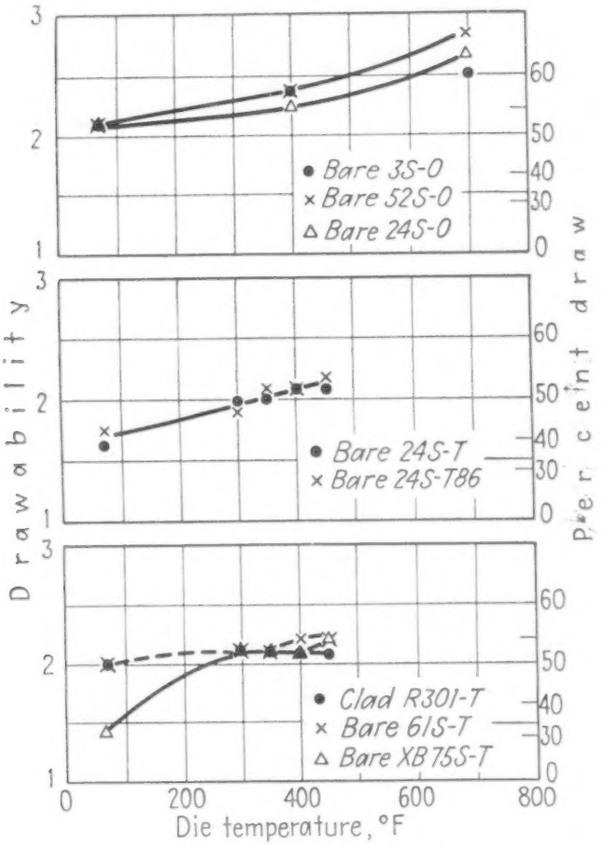


FIG. 2—Effect of die temperature on drawability of aluminum alloys.

70° F. This suggests the possibility of deep drawing 24S-T series alloys at 450° F for structural or semi-structural applications in lieu of deep drawing 24S-O at 70° F and then heat treating. By this technique the complications arising from warpage during heat treatment may be overcome and the production steps are simplified.

The general trends obtained for drawability of the high strength group 2B alloys are similar to those for group 1B. XB75S-T exhibited the poorest drawability of the group at 70° F, but so great was the improvement with increase in temperature that at 450° F it had a drawability equal to the greatest which was obtained for other alloys in this group. Alloy R301-T exhibited only slight improvement in drawability with increase in temperature. Comparison of the maximum height of cups produced from 24S-T86 and 24S-T shows that the former has better deep drawing properties than the latter. Conditions of drawing which yield major changes in thickness of the cup walls and conditions of sheet anisotropy which lead to the development of ears on the drawn cup preclude the possibility of interpreting the per cent draw or the drawability in terms of the useful dimensions of the finished product. This difficulty may be surmounted by reporting the deep drawing characteristics in terms of the relative height of the cup.

The effect of clearance* on drawability is not very

*Clearance is defined as:

$$\text{pct clearance} = \frac{D_d - (d_p - 2t)}{2t} \times 100$$

where, D_d = die diam, D_p = punch diam, and t = original thickness of sheet

marked, although 52S-O, XB75S-T and R301-T gave greater draws for dies with 4 pct clearance than for dies with 83 pct clearance (at 450° F), while 24S-T, 24S-T86 and 61S-T showed no change over this range.

Deep Drawing Boxes

In part II of the report, the authors pointed out that the investigation was conducted to determine whether the improvement in deep drawing at elevated temperature for cylindrical cups applied also to box-type parts. The equipment used was essentially the same as that used for the cylindrical cups, except that for this investigation, interchangeable die inserts and punches for a series of six corner die radii ranging from 1/16 to 1½ in. (round die) and for variable corner clearance using 1/16 and ⅜-in. corner die radii, were used. The corner clearance is defined as the distance between the corner wall of the punch and land of the die minus the sheet thickness measured along a line bisecting the corner angle.

The alloys investigated were as follows:

Group	Alloy
1A	none
1B	24S-O, 75S-O, XB75S-O
2A	24S-T
2B	24S-T81, 24S-T86, 75S-T, XB75S-T

In order to reduce the number of tests, the forming temperatures studied were limited to atmospheric temperature and 450° F. Although higher forming temperatures can be used for deep drawing the group I alloys, 450° F was selected inasmuch as the general aging characteristics of the group II alloys preclude the use of higher temperatures.

The significant measures of the drawability considered are (1) the h/d ratio, where h is the maximum trimmed height of the box and d is the inside width of the box (width of punch) and (2) per cent draw defined by:

$$\text{Pct Draw} = \frac{(D_b - d)}{D_b} \times 100$$

where D_b = blank diam. The maximum h/d ratio presents a measure of the maximum final height of

box for a given set of drawing conditions, whereas the per cent draw gives a measure of the maximum blank size that can be drawn for the same conditions. Generally the height of cup is a more informative measure for design and production use, although both are required if an actual part is to be formed, since a size of blank must be selected that can be drawn to the desired height.

Improved drawability at 450° F over drawability at 70° F was obtained for all the alloys tested. Further, at 450° F, all of the T-temper alloys tested permitted maximum draws equal to or greater than the maximum draws obtainable from 24S-O alloy at 70° F. The maximum drawabilities of the T-temper alloys tested, arranged according to decreasing drawability, are in the order of XB75S-T, 24S-T86, 24S-T81 and 24S-T.

The O-temper alloys tested, XB75S-O and 24S-O, gave a very large increase in drawability at 450° F over that obtained at 70° F.

The improvement in drawability at 450° F as compared to 70° F was the greatest for the high strength alloys. The results warrant consideration of deep drawing in the hardened temper at elevated temperatures rather than deep drawing in the annealed condition at atmospheric temperature and subsequently heat treating and aging.

Several developed blanks were investigated in an effort to increase the maximum per cent draw and height of box producing a box without ears. A slight increase in height of box was obtained by removing a small amount of material from the area from which the ears formed, but when sufficient material was removed to produce a box without ears, severe wrinkles were formed along the corners. In general, a circular blank shape was the most satisfactory for producing square box-type parts.

Effect of Tellurium Corewashes on Shrink Defects

Use of tellurium base corewashes as a solution for some troublesome gray iron foundry problems, particularly shrinks, was suggested in a paper by J. O. Vadeboncoeur, research metallurgist, Pontiac Motor Div., General Motors Corp., Pontiac, Mich., presented at a Tuesday ASM session.

The report, entitled "Tellurium Corewashes," pointed out that use of tellurium as an alloying agent in gray iron foundries has been somewhat limited, but is finding increased popularity as a means of selective control of casting structure. This control was said to be most easily achieved through the use of cores dipped or painted with washes containing the suspended metal.

The author reported that by painting a 1-in. stripe of tellurium corewash on the core at the oil galley line where the stud bolts enter, a bad shrink on diesel cylinder blocks had been eliminated. Another shrink on a stud bolt boss on the water jacket of a truck cylinder block was eliminated by a spot of tellurium corewash. The successful mass production of diesel cylinder liners in a horizontal position was said to have been made possible by dipping the liner cores in a tellurium wash.

These liner cores were dipped in a shallow tank immediately after removal from the core oven. A rod was placed through a vent hole which passed through the longitudinal axis of the cylindrical core. The core was revolved about the rod while immersed in the tank. An evenly applied coating was thus obtained which dried rather rapidly. It was found that best results were obtained when the specific gravity of the wash was held to 33° Be.

TABLE I

	Pct
SiO_2	65-68
Fe_2O_3	2
Al_2O_3	6
Te	23-25
Se	trace
Ta	trace

The laboratory analysis of the tellurium corewash paste, carrying about 20 pct moisture, in successful use for producing a local chilled area on several different castings is shown in Table I.

The author stressed that in the original paste form the material is far too potent to be handled by production personnel. To overcome this the washes were mixed under laboratory supervision. One of the mixtures which met with particular success in production work consisted of 750 g (1.65 lb) of the original paste to five liters (5.28 qt) of water. One volume of this in turn is mixed with five volumes of No. 798 Plumbago wash at 27° Be. Another mixture developed for its property of suspension consists of 10 pct tellurium paste, 5 pct bentonite, 5 pct silica flour and 80 pct water. One volume of this mixture is added to four volumes of 798 Plumbago wash at 27° Be. The resulting mixture holds quite well in suspension.

Care in application was urged in the paper, for if the wash is misplaced or too generously applied, the resulting chill might easily be cause for scrapping the casting. Migration of the chilled portions may also occur.

Mr. Vadeboncoeur suggested two possible methods by which the tellurium from the corewash was introduced into the iron; elemental atoms of tellurium may diffuse into the iron, or the diffusion of the vapors themselves may be instrumental in uniting the two metals. Conclusive evidence is lacking, the author pointed out, for either argument, but after observing the gases associated with every experiment conducted on this metal, he was inclined to favor the vapor diffusion hypothesis.

In either event, he said, once the tellurium becomes incorporated as an alloying agent within the iron, the carbides are completely stabilized for a uniform depth on the surface of the casting. The

depth of the chilled area depends only upon the amount of tellurium present in the wash and can be varied to suit the requirements of the job.

Tellurium corewashes appear to be particularly effective in preventing shrinks. The hypothesis advanced by some foundrymen to explain this property is that the viscosity of the metal is raised at the mold-metal interface. It is equally probable, the author stressed, that the diffusion of tellurium increases the crystallization velocity of the melt and thus causes it to solidify more quickly under the same molding conditions.

Lester Lecturer Stresses Nondestructive Tests

HIGHLIGHT of the fifth annual meeting of the American Industrial Radium and X-ray Society, held in conjunction with the Metal Congress, was the presentation of the Second Lester Lecture by O. R. Carpenter of Babcock & Wilcox Co., on Wednesday.

The speaker was introduced by Dr. Lester, who paid high tribute to both Mr. Carpenter and his company, for the outstanding work done by them in making radiography an important and practical industrial tool.

In announcing the title of his talk, "Advances in Steel Weldments in the Past Few Years," Mr. Carpenter stated that this was somewhat of a misnomer, since he intended to concentrate chiefly on the application of the various nondestructive tests for examination of weld soundness, which had been instrumental in making possible high quality welds in pressure vessels of heavy wall thickness.

Tracing the development of these tests from the early hammer and stethoscope, through the magnetic types, and the Sperry supersonic units, he showed how Dr. Lester's work with radiographs had proved so successful as to lead to the establishing of standards of acceptability by radiographs. He described the operation of the Sperry supersonic reflectoscope and by means of lantern slides demonstrated how indications shown on this instrument could locate interior flaws in either weld or parent metal, proving this by micrographs taken through the same sections. He emphasized, however, that there was still considerable work to be done and experience to be gained by experimental use of the instrument, before it could be applied successfully to light sections.

At the conclusion of the lecture Mr. Carpenter was presented with the Lester medal in appreciation of his outstanding work.

Graphitization in Hypo-Eutectoid Steels

A REPORT on susceptibility of hypo-eutectiod Steel to graphitization when cold rolled and annealed at subcritical temperatures was contained in a paper presented at an ASM session by [illegible]s. Hughes and J. G. Cutton, Carnegie-Illinois St[illegible]Corp.

In the past two or three years there has been a material increase in the requirements for cold rolled annealed carbon steel strip. In the processing of such material little or no consideration has been given to the possibilities of graphite formation in the annealing operation subsequent to cold rolling, the paper pointed out. It has been found, however, that under certain conditions graphite may be formed in cold rolled annealed hypo-eutectoid carbon strip and, once formed, may be eliminated by subsequent thermal treatment.

A study was made to determine the effect of temperature, residual alloy, variations in per cent cold reduction, mode of deoxidation and full annealing prior to cold reduction and carbon content on the susceptibility of hypo-eutectoid steels to graphitization when cold rolled and annealed at subcritical temperatures. By cold rolling and annealing the strip at subcritical temperatures it was observed that graphite formed under certain test conditions. The solution rate of graphite in cold rolled annealed strip samples was also determined for three of the steels investigated.

Among the conclusions noted by the authors were: the optimum temperature range for graphitization of cold rolled strip was observed to be 1150° to 1250° F. Any variation from this temperature range decreased the probability of graphite formation. Annealing times longer than those generally employed in commercial annealing were required to graphitize the cold rolled strip, and chromium was found to stabilize the carbides, while copper appeared to have no effect upon the stability of the carbides.

When cold rolled strip samples were subjected to two cold reductions totaling 50 pct reduction, and two subcritical anneals totaling 144 hr at 1200° F, it was observed that first reductions of 10 pct, 20 pct and 30 pct produced more graphite than 0 pct, 40 pct and 50 pct first reductions.

Hot rolled strip, made by a coarse grain deoxidation practice, did not graphitize when subjected to cold rolling and annealing procedures which readily produced graphite in similar steels made to a fine grain deoxidation practice. From this observation it is reasonable to assume that aluminum or alumina, perhaps both, are important factors in permitting subcritical graphitization. Full annealing the hot rolled strip prior to cold reduction and subcritical annealing was observed to greatly enhance the graphitization.

Hot rolled strip samples secured from fine grain heats having carbon contents of 0.08 C, 0.43 C and 0.67 C and one heat of silico-manganese were graphitized by cold rolling and subcritical annealing. The solution rate of graphite in cold rolled annealed strip samples at heat treating temperatures is a function of the temperature, the graphite particle size, and the amount of graphite present.

New Lathe for Small Turning Work

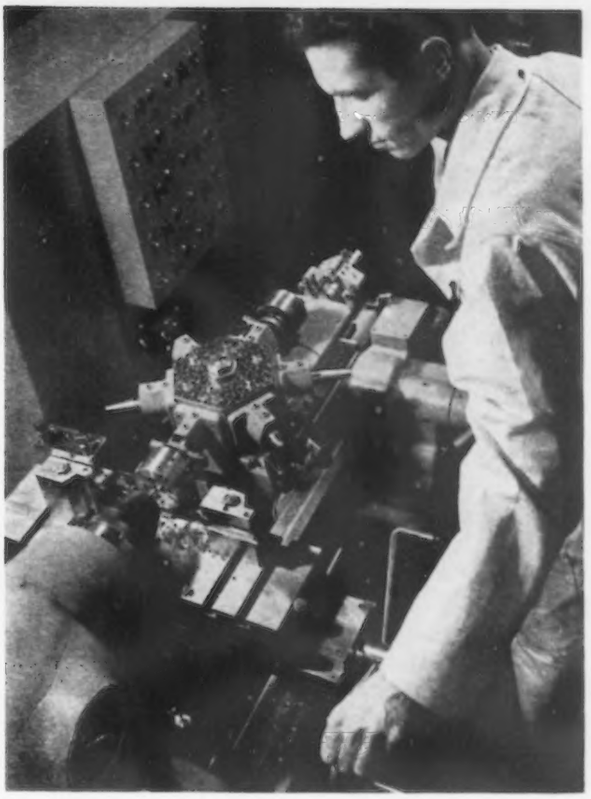


FIG. 1—The new Speed-Matic manufacturing lathe introduced by Monarch for high-production work. It features a precision turret with 12 feeds, and automatic speed changes for each turret position.

DESIGNED to handle small turning work in quantities of from 25 to 500 or more pieces with ease and quickness of setup, a new high production, hand screw machine has been announced by the Monarch Machine Tool Co., Sidney, Ohio. Equipped with power feed ram type turret, hand operated cutoff slide, and preselected changeable spindle speeds ranging from 50 rpm to 5000 rpm, it is said to be one of the highest production units of its kind in the field.

The power feed turret has built into it an additional six feeds to the turret slide which, combined with the high and low feed of the main gear box, gives a range of 12 feeds. These range from 0.0005 in. per rev to 0.016 in. per rev. The turret slide is manually operated by capstan handwheel and is power fed through the rod which connects to the main gear box. The turret will index to six stations within 0.0002 in., out 2 in. from the face thereby assuring repetitive accuracy on close tolerance work.

A hand-operated, air-fed pusher-type collet is employed, and constant air pressure on the bar stock is sufficient to feed stock through the collet to a stop on one face of the turret. By opening and closing the collet, the stock is fed through and held in position for machining.

The self-centering, ball-bearing cutoff slide is operated by turning the handwheel through 100° or less to present either front or rear tool to the work. Tools are hand fed for the forming, necking or cutoff operation, but the slide returns to its original position by means of a spring and helical rack mechanism, without the aid of the operator.

A motor-generator set is used for converting ac to dc for the machine drive and controls. The relay panel for the machine houses the potentiometers and other electrical equipment necessary for automatically changing spindle speeds to conform to the requirements of the tool for that particular operation. Spindle speeds for each face of the turret, as well as the cutoff slide, are preselected to their proper position by means of these potentiometers.

Whenever the turret indexes, as application is made of all tools, it comes back against a finger which automatically changes the speed for the next operation by controlling the circuit through the potentiometers. The ten-station panel has six stations for the six sides of the turret, two stations for the front and rear cross slide tools, and two additional speeds for other operations such as forward and reverse for tap or die work. Immediately to the right of the speed change finger is a reset button operated by hand. By using the reset button, the entire panel is returned to its original starting condition which remains unchanged until the turret is indexed for the first spindle speed needed for the initial operation.

The gear box, with all moving parts hardened and ground, has been simplified in design, and screw cutting parts have been omitted as they are not necessary with this machine. The spindle is hardened and ground and is mounted in precision ball bearings. The spindle bore will accommodate bar stock up to ⅞ in.

New High-Speed Milling Technique

MILLING developments during the past year or two have shown a decided trend toward the use of a minimum number of teeth or blades, particularly in face milling, despite the fact that this necessarily results in a greatly increased load per tooth. Increasing emphasis has also been placed on the necessity of providing ample room for the chips to pile up in front of the blade. By the application of both of these principles of cutter design there have been some remarkable increases in the rate at which metal can be removed, but a completely new cutter introduced by General Tool and Die Corp., E. Orange, N. J., would seem to indicate that even better results

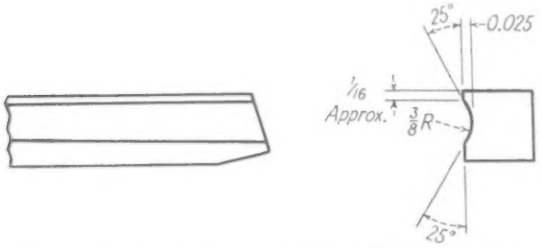


FIG. 1—Cushioned 12-pct cobalt high-speed steel blades are grooved to produce a shearing action, and are copper plated all over.

can be obtained by a complete reversal of this line of thinking.

The cutter in question consists of a steel or centrifugally cast iron body, conical in shape, and having two rings brazed on to the circumference. The blades are located in grooves in the body and are retained by two 5/16-in. setscrews carried in the rings. Twelve pct cobalt high-speed steel is used, and each blade is cushioned by a strip of copper brazed on the back.* In addition, each blade is copper plated all over to increase the coefficient of friction between the body and the blade, and thus to minimize the possibility of the blades slipping. It is this added friction that is largely responsible for the extremely simple design of the cutter body.

*For further information on cushioned high-speed steel tools, see THE IRON AGE issues of Nov. 29, 1945 and July 20, 1944.

On a 6-in. diam cutter, 20 3/8-in. sq blades are used, and on a 12-in. cutter, 60 blades, and these are of unusual design as shown in fig. 1. A groove is formed parallel to the longitudinal axis of the blade, creating a severe shear angle in two directions at the bottom of the blade, and producing a fine finish on the work even when taking a roughing cut. The shear angle now being used is about 25°. A positive rake angle of 5° is employed, although it is admitted that there is considerable research work to be performed on angles, since there are indications that all previous knowledge of clearance and rake angles having to do with high speed steel may have to be revised. Good results are obtained with conventional angles, but there is considerable improvement when larger rake and clearance angles are employed. The hardness of the blades is between 67 Rc and 69 Rc, but despite this high hardness it appears almost impossible to chip the cutting edge.

Actual cutting tests carried on over a number of weeks have produced some remarkable results, with a rate of metal removal far higher than could be obtained by the use of ordinary high speed steels, and in some cases twice as high as could be obtained with carbides. Materials with a hardness as great as 600 Bhn have been milled with surprising ease. On Max-L shank steel, which is similar to SAE 4150 and has a hardness of 280 Bhn and a tensile strength of 140,000 psi, a cutter speed of 370 fpm was used. Speeds as high as 550 fpm were tried without injury to the cutter, but no gain in rate of metal removal was experienced, as this merely reduced the amount of feed per tooth. The machine was a 35-yr-old No. 3 Vertical Kearney and Trecker Mill in very poor condition, and it is believed that even better results could be obtained with newer, more highly powered equipment. With a depth of cut of 1/16 in., and a feed of 25 ipm, a total of 9.37 cu in. per min was removed. Power input to the tool was 2 hp, giving a rate of 4.68 cu in. per hp per min, or more than five times the normal maximum. When the depth of cut was increased to 1/8 in., the motor became badly overloaded, the power input being 9 1/3 hp. Stock removal was 18.75 cu in. per min, but the cu in. per hp per min dropped to 2. At 100 ipm and a depth of 1/32 in., power input was 4 1/3 hp, giving 4.33 cu in. per hp

per min stock removal. Doubling the depth of cut dropped the rate to 2.75 cu in. because of the heavy motor overload of 13 2/3 hp. Lowering the cutter speed, however, to about 120 fpm, and increasing the feed to 3/32 in. caused a drop in the power requirements, despite the high chip load of 0.062 in. per tooth, and it is not believed that the maximum has yet been attained.

One of the most remarkable features of these operations is that the work remains cool, and the chips are not heated sufficiently to show any color. There is no noticeable vibration in the machine, and practically no noise beyond a slight swish as the cutter passes through the material. The protesting screech of riven steel usually heard in high-speed milling is entirely absent.

On Meehanite with a hardness of 190 to 200 Bhn. equally remarkable results have been obtained. With a depth of cut of ⅛ in. and a feed of 250 imp, actually the rapid traverse of the machine, 38 cu in. per min were removed. At 100 ipm and a 1/16-in. cut 38 cu in. per min were removed, while at the same speed and a 3/32-in. cut the rate increased to 55 cu in. per min.

Another development closely connected with cutter performance is the grinding of the blades on the milling machine itself. Even the best of machines are apt to have some spindle runout, and it is believed that in many cases poor cutter performance can be attributed to the fact that while the cutter runs perfectly true with the grinding machine spindle, absorbing any runout this may have, it no longer runs true when mounted in the mill, and actually has a runout amounting to that of both grinder and mill. When ground on the mill, however, this difficulty is overcome, and the tool will run true regardless of the spindle runout. At the present time, a small portable grinder is being used, mounted on a tilting, reciprocating plate, but a new grinding fixture is being designed which will sharpen a 6-in. cutter in about 20 min.

FIG. 2—A 6-in. cutter uses 20 blades in a body of very simple design. Blades are held by two setscrews.

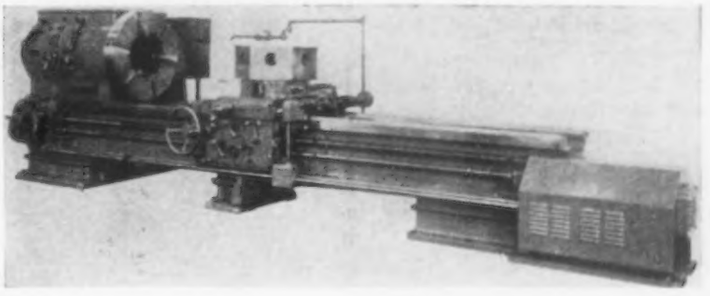
Automatic Turret Feed Regulator for Lathes

NOW available on Lehmann Hydratrol lathes is an automatic turret feed regulator having automatically positioned longitudinal and cross-feed stops. Illustrated here is a 36-in. swing machine equipped with a 24-in. hexagon turret, and having a 16½-in. spindle hole.

The indexing of the turret accomplishes four things: first, it brings a new turret face into the work area; second, it indexes a set of front and rear cross-slide positioning stops; third, it indexes a set of longitudinal stops that may be used either for positioning a cross-feed cut or as a precision longitudinal feed stop operating a magnetic brake on the feed rod drive through the action of Micro Limit Switches; fourth, it automatically regulates the rate of feed by means of a six position rotary cam.

The feed-regulating cams for each turret face are independently adjusted through a wide range by means of adjusting screws and a calibrated chart attached to the machine.

This automatically regulated feed rod drive does not interfere with the operation of the standard lathe quick change feed gear box either for feeds or threading. The handle used to disengage the automatic drive is electrically interlocked to prevent the simultaneous application of power thru both drives. Threads may be cut with the turret, using the leadscrew without disengaging the automatic drive. This is accomplished by use of a half nut engaging a handle on the apron.



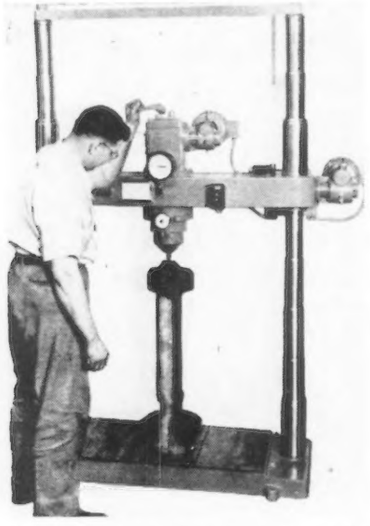
LEHMANN lathe with automatic turret feed regulator indexed for longitudinal and cross-feed stops. Indexed turret brings a new turret face into work area, indexes front and rear cross-slide positioning, indexes a set of longitudinal steps for a cross-feed cut or for precision longitudinal feed stop operating a magnetic brake on the feed rod drive through a Micro limit switch, and regulates rate of feed by a six position rotary cam.

New Equipment . . .

Lab Equipment

. . . In this week's issue are described interesting developments in lab equipment, including stack analysis, chart drive-cut outs, temperature controls, silica blocks, program timers, potentiometer controllers, diffraction units, magnetic testers, gauss meters, and a few other items.

A MACHINE for the Brinnel testing of heavy and hard to handle specimens, has been announced by the *Steel City Testing Laboratory*, 8843 Livernois, Detroit 4. It is identified as type A-4 and can be setup in an assembly line or any other position to suit the test requirements. It comes equipped with either standard Brinnel microscope for reading diameter of impression, or with



direct reading attachment. This machine is said to have overload protection and screws with collapsible covers.

Chart Drive Cut-Out

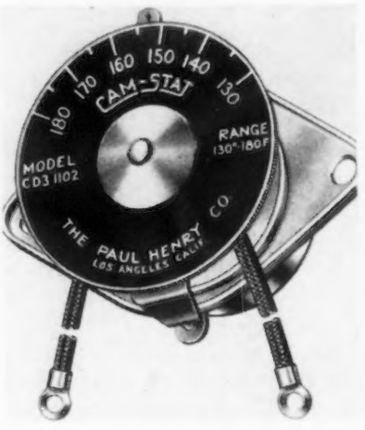
A CHART drive control, embodying means for automatically starting and stopping electronic recorder chart motion by pen position, has been announced by the *Brown Instrument Co.*, Wayne and Roberts Ave., Philadelphia, industrial instrument division of *Minneapolis - Honeywell Regulator Co.* The chart drive cut-out. it is claimed, will be available for Brown's circular chart Electronik Recorder. Control contacts are wired in the chart drive circuit. By setting the control point, the chart can be stopped and started as desired, corresponding to any pen position. The new feature will find its greatest usefulness for molten metal thermocouple and radiation pyrometer applications.

Stack Analysis Instrument

KNOWN as the Stack-O-Meter, for indicating CO_2 stack temperature and draft readings, a small portable instrument has been announced by *The Davis Emergency Equipment Co., Inc.*, 45 Halleck St., Newark 4, N. J. Among the features of this instrument is the fact that all readings are taken on one meter, CO_2 percentage readings are obtained from gas samples collected through a hand aspirator bulb, stack temperatures are read on the same dial, obtained electrically from a thermocouple mounted in the gas sampling tube, and draft measurement is obtained through a separate tube, but read on the same meter. This instrument is designed for use by service or maintenance men wherever there is a need for a portable instrument for analysis of combustion. It is said to be rugged in construction, and can be conveniently carried by hand or auto without danger of breakage, spilling or freezing of liquid.

Temperature Control

MANY advantages are claimed for a new line of Adjustable Calibrated Cam-Stat Temperature Control announced by *Paul Henry Co.*, 2037 S. La Cienga, Los Angeles 34. Among these are said to be a precise dial selection of the temperature control point with uniformity of dial accuracy in all units, virtually no increase in space required for mountings or in cost over other thermostats without calibrating dial, tamper-proof dial installation preventing changing of adjustable range provided at the factory and a ready adaptability to specially styled adjusting knobs and other design requirements. A wide variety of mounting means are claimed for adapting the unit to the control of air, gas, liquid or solids.



Silica Block

A SILICA block for measurement of crown temperatures in glass tanks has been announced by *Brown Instrument Co.*, Wayne and Roberts Ave., Philadelphia, for use with Radiamatics and radiation pyrometers. The silica block is said to have three additional advantages, namely: (1) More constant calibration than is usually experienced with thermocouples. (2) More open scale division throughout the operating range. (3) Lower net cost. The single hole silica block is installed flush with inside roof surfaces. It is sometimes installed so that the bottom of the block extends into the furnace for several inches. The Radiamatic is sighted into an 18-in. Sillimanite target tube which is installed in the block to within ¼-in. of the bottom. An air-cooled fitting only is necessary to prevent overheating of the Radiamatic under normal operating conditions. The target tube is maintained under a slight positive pressure by connecting to a low pressure air supply.

Analytical Combustion Tubes

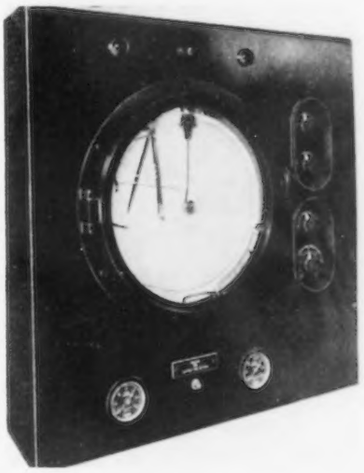
AN improved combustion tube assembly for carbon and sulfur determination in metals and other combustible materials has been announced by *Harry W. Dietert Co.*, 9330 Roselawn Avenue, Detroit 4. Two lengths of cylindrical refractory tube liners are inserted within the combustion tube. The combustion tube assembly is inserted within a high temperature laboratory combustion furnace. The boat containing the weighed sample is placed within the liner at the center of the combustion tube. The center liner protects the combustion tube from the metal and slag splatter. When the center liner becomes so full of splatter that it interferes with the boat passage, it is removed and a new liner is inserted.

Ultra Gage

THE precision Televac ultra vacuum gage, Type E-31, has been announced by *Precision Scientific Co.*, 1750 N. Springfield Avenue, Chicago 47. Electrical leakage is eliminated and when used with a moderately high speed pumping system, the gage is said to outgas itself. The filament is protected before and during operation automatically in that current will not enter the filament before the pressure of 1 micron has been established and turns off automatically if pressure rises above 1 micron. Gages are interchangeable without recalibration and are guaranteed for 1000 hr. The standard E-31 ionization gage comes on scale at 0.4 micron (4 x 10-mm Hg.). The gage is used with the Televac Type S recorder.

Controller

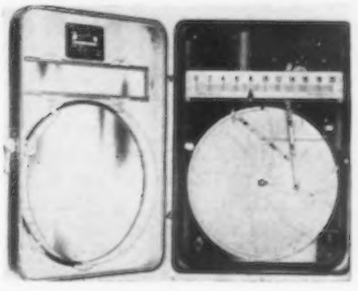
FOR batch-type processes and other operations where rate of temperature increase or decrease



must be controlled, as well as the actual processing temperature and duration, The Foxboro Co., Foxboro, Mass., has announced the CycleLog Controller, now available as a standard item in the company's line of instruments for measurement and control. No time cams or supplementary instruments are employed, and its control is completely automatic, according to whatever schedule is predetermined by adjustments of four setting knobs on the instrument panel.

Potentiometer Controllers

A SERIES of electric-type potentiometer controllers has been announced by the *Bristol Co.*, Waterbury 91, Conn. Five basic control unit types are available. Three are electric contact types to



be known as the Microact controllers and the other two are Electric Proportioning and Current Input types. The control units are mounted on the internal panel of the Bristol Pyromaster Recorder and any type may be readily converted to any other type by following simple wiring and mounting instructions. The three Microact units are provided with one, two and three precision-type toggle switches respectively and six different terminal board connection arrangements to meet a wide assortment of control circuit requirements. Proportioning controllers may be used with any type of electric proportioning valve and may be had with resetting contacts if required.

Program Timer

SYNCHRONOUS motored for the greatest possible accuracy of signals at any 5 min period in a 24 hr schedule with circuit closure from 5 to 60 sec precisely at the time specified, the model P5-24 program timer has been announced by *Zenith Electric Co.*, 152 W. Walton Street, Chicago 10. The timer is an automatic switch which can be set to as close an electrical circuit at any desired 5 min interval as desired. As many as 288 operations a day are possible. The program mechanism is set by turning the minute hand as on an ordinary clock, and small spring brass clips are inserted in slots of program disk for the program desired. Operation is performed by a set of cam-operated silver contacts which operate with snap action.

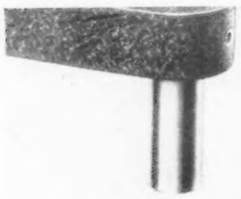
Diffraction Unit

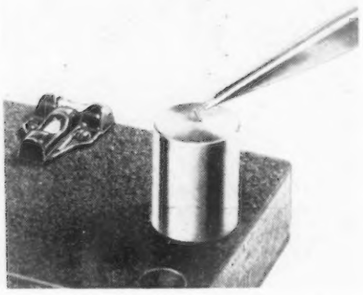
FOR the solution of analysis problems such as the presence or absence of preferred grain orientation in metals, particle size determination of fine materials, etc., the Norelco X ray diffraction unit using the low-angle-scatter camera has been announced by *North American Philips Co., Inc.*, 100 East 42nd Street, New York, 17. The X ray diffraction unit has a four windowed tube enclosed in a bronze housing. Diffraction patterns of four different specimens can be obtained simultaneously. A number of X ray tubes can be provided included in which are targets of tungsten, molybdenum, cobalt, iron, chromium and copper. Tubes can be changed quickly. Fully shockproof and ray-proof, the unit

utilizes full wave rectification. Circular powder cameras are also available for use with the Norelco analyzer.

Magnetic Tester

A MAGNETIC hardness tester for rapid, accurate gaging of hardness of small, ferrous, metal parts has been announced by *General Electric's Meter & Instrument Div.*, W. Lynn, Mass. Providing a convenient "go—no go" hardness gage, this tester is said to simplify inspection of such parts as electric-instrument pivots and shafts, watch shafts, small steel balls, and other parts too small to be produc-





tion-tested with mechanical-type hardness testers. It is also claimed to permit spot checking of hardness in large sheets, or lengths of steel wire, through the comparison of random-selected small samples. The operation of this tester is based upon the correlation of hardness and coercive force in magnetic materials. It checks pieces of unknown hardness against a specimen of known hardness by comparing, in a simple, mechanical test, the relative strength of the magnetism produced in the test pieces and in the standard specimen, under the same conditions of magnetization.

Laboratory Hot Plates

THE Lindberg line of laboratory hot plates with working temperatures from 110F° up to 950°F for such varied and routine laboratory jobs as boiling, evaporation and heating, has been redesigned to give more efficient service, according to an announcement by *Lindberg Engineering Co.*, 2450 W. Hubbard St., Chicago 12. Improvements include mounting the electrical input control on the front of the hot plate. This control permits the manual selection of any degree of heat within the temperature range of the hot plate. It is this principle of input control, according to the company's statement, that has been so successfully used for many years on industrial furnaces. These hot plates come in three different sizes, are fitted with top plates made of extra heavy special metal that, it is claimed, resists growth and warpage as well as corrosion, and minimizes discoloration caused by spillage.

Midget Impinger

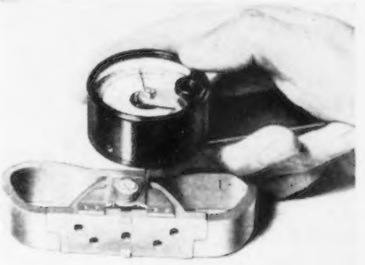
ALL-GLASS sampling units for use with the M.S.A. Midget Impinger have been announced by *Mine Safety Appliance Co.*, Braddock, Thomas and Meade Sts. Pittsburgh 8, The Midget Impinger, widely used in dust sampling, is a small, light, compact instrument, providing convenient portability with easy hand operation in surveying dust hazards. The all-glass construction of the impinger units is said to permit easy and thorough cleaning and prevents contamination or discoloration of the sample undergoing test. The air outlet in these units is placed at a maximum height, and the possibility of drawing over any of the collecting fluids is practically eliminated. These all-glass sampling units consist of a flash and nozzle with a standard taper ground-glass stopper. A fritted glass bubbler is also available. This equipment makes possible the sampling of a wide variety of dusts, gases and vapors.

Portable Magnetic Inspector

A PORTABLE Magnaflux unit, Type KH-2, designed especially to provide a source of suitable current for inspection in foundries and welding shops and for inspection of refinery equipment, pressure vessels and heavy machinery has been announced by *Magnaflux Corp.*, Chicago. It has a wide scope of inspection applications as it delivers both high-amperage low-voltage current for dc magnetization and also high-amperage low-voltage ac for demagnetization after inspection. Heavy duty dry-plate rectifiers deliver single phase, half-wave rectified current for dc magnetization, offering maximum sensitivity with minimum equipment requirements. The availability of both ac and dc magnetization as well as demagnetization permits the use of ideal methods for a great variety of applications.

Gauss Meter

SIMPLIFYING the measurement of flux of permanent magnets and dc electromagnets, a gauss meter has been announced by *General Electric's Meter & Instrument Div.*, W. Lynn, Mass. It is said to be a handy tool for checking flux gradients in air gaps and for determining the direction, as well as the density, of flux in leakage paths and air gaps. Utilizing a moving-magnet rotor at the end of an exploring prod, this hand-held minia-



ture instrument permits flux to be measured at what amounts to a single point in either the air gap or the iron structure. Among the applications for this meter are: Checking flux density and distribution in electric instruments, measuring flux in arc blowout chutes and contactor blowouts, production testing of permanent magnets, and checking electromagnets and relay coils.

Gas Analyzer

PIONEER manufacture of gas analyzing equipment, the *Hays Corp.*, Michigan City, Ind., has announced a special analyzer for testing the high purity of oxygen, carbon dioxide, and nitrogen in the range from 90 pct to 100 pct. It is of particular interest to the manufacturers of commercial oxygen and carbon dioxide but has many practical uses also in industrial processes. This analyzer known as the Hays Series "E" came into being as the result of the demand for testing the high purity of oxygen for use in flying. It is quite similar to the standard orsat but its technique in operation differs somewhat. It is offered in two styles, a wall mounted model for permanent installation and a portable model supplied in a neat metal case with leather carrying handle. It may also be had with a single unit or with two units.

In the Sperry Rail Welders, Oilgear grips rail ends, positions, aligns, and holds them with increasing pressure while establishing welding contact, releases welded rails, moves into position for next cycle.

Do you need tremendous power or little power . . . exquisitely applied? *Then call in Oilgear*

Did you know that standard railroad rails can be welded together in homogeneous units thousands of feet long? That they can be welded on the right-of-way, the increasing length stretching out behind on flat cars and easily negotiating 15 degree reverse curves in the track? That it's all done automatically, eliminating the human element? And that Oilgear Fluid Power furnishes not only the tremendous power to grip the massive load but the tremendous precision that matches perfectly the faces-to-be-welded with increasing pressure which climaxes in the final weld?

You may need power that can be applied with precise control . . . power that can be increased or decreased smoothly and instantly . . . infinitely variable speed . . . automatic work cycles . . . extremely accurate control of position or speed of a reciprocating member . . . constant horsepower output through all or a part of a speed range . . . or any of scores of other functions. Whatever your straightline or rotary power transmission problem you will find a better solution in Oilgear Fluid Power. Write now without obligation. THE OILGEAR COMPANY, 1303 W. Bruce St., Milwaukee 4, Wisconsin.

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1. Apply large forces through long . . . or short . . . strokes at variable speeds? **2.** Obtain automatic work cycles, variable speeds in either direction . . . with or without preset time dwell? **3.** Apply large forces through continuous or intermittent reciprocating cycles at constant or variable velocities? **4.** Obtain extremely accurate control of either position or speed of a reciprocating member? **5.** Apply accurately variable pressure either static or in motion? **6.** Closely synchronize various motions, operations or functions? **7.** Apply light . . . or heavy . . . forces at extremely high velocities through either long or short distances of travel? **8.** Obtain continuous automatic reversing drives at constant R.P.M. or over a wide range of speed variation? **9.** Obtain accurate remote control of speed and direction of rotation, rates of acceleration and/or deceleration? **10.** Obtain constant horsepower output through all or part of a speed range? **11.** Obtain automatic torque control? **12.** Obtain accurately matched speed of various rotating elements? **13.** Obtain constant speed output from a variable speed input? **14.** Obtain full preset automatic control, elimination of problems of shock, vibration, etc.?

You Need Oilgear!

Assembly Line . . .

STANLEY H. BRAMS

• Although the strikes are cutting output of automotive vehicles to postwar lows, only the GM and steel tieups are in the picture to impair production and prospects.

DETROIT—Six weeks ago the labor skies here were completely overcast, hemmed in at every point by menacing clouds. Today two huge blurs—the General Motors strike and the steel strike—are darkening the outlook, but it is quite obvious that once these two single disturbances are cleared up the picture will be most materially changed, almost bright in fact. The entire scene today confirms what was written here three weeks ago, that the worst of the nation's labor trouble is at hand and that improvement will be seen before too long.

General Motors negotiations dragged last week but there were indications that the entire bargaining was doing little more than mark time while a settlement formula of broad nature was being drafted in Washington to end the steel walkouts. Certainly the steel strike is a barrier to any settlement in General Motors, because from the practical standpoint GM has little incentive to settle a tieup which could be only continued a few days after work resumed because of lack of material. Cleanup of the steel problem on top of the recent settlement of the glass workers' strike would leave the way open for sustained production, particularly since the agreement patterns which have been drafted in recent weeks give apt evidence of being communicated from the major concerns down to the smaller ones, thus indicating an easing of the entire picture. Also, once steel is settled, Chrysler and Ford having already reached working agreements, General Motors will probably be in somewhat difficult position from its public relations standpoint, and this factor will be in the picture.

This is not to say that the road will be easy. General Motors is making a most determined fight to eliminate the maintenance of membership provisions which were inserted in its contract during the war by the National War Labor Board. Put into the contract over the protests of the company, it is one clause which GM—in common with most other manufacturing companies—wants most intensely to see eliminated. By the same token, the CIO United Auto Workers Union wants it retained. The dispute over maintenance of membership probably is the most formidable problem existing today in the General Motors negotiations. Indications from the company, the union and federal conciliator James Dewey uniformly point to the likelihood that the wage issue, so hotly argued earlier, is no longer a factor, now that Chrysler and Ford have settled at the 18½c level, and now that the union has retreated from its earlier position of insisting the award be based on ability to pay.

In another sector, the UAW has won a notable victory in keeping maintenance of membership in an existing contract. This is with Briggs Mfg. Co., whose representatives concluded negotiations late last week with the auto union with announcement that terms of a new contract had been arrived at. Briggs will pay an 18½c raise, and has increased vacation bonuses to $52.50 for workers of one to five year seniority, and double that amount for workers with more than five years' seniority. This Briggs case is the first in which maintenance of membership has arisen as a factor and been disposed of.

One other interesting proviso in the new Briggs agreement is the setting up of a citywide seniority system for all employees. Briggs operates several plants within the city, most of them doing the same general type of sheet metal work, stamping and forming, and there-

DEAD-END: *The trimming room of the Ford Motor Co.'s assembly plant in Edgewater, N. J. has been closed down due to lack of steel caused by the steel strike. Between* 1500 *and* 1800 *employees have been made idle for an "indefinite period."*

CONTROL STATION

on the PRECISION-PRODUCTION LINE

The AIR-O-LIMIT Gage Works Right at the Machine

The Pratt & Whitney AIR-O-LIMIT Internal Comparator will work wherever there is a handy air connection—at the bench, in a gaging room—*or right at the machine.*

Often, it is desirable to establish a control station at the machine. Here, the operator can check any part quickly and accurately as it comes off the machine. This serves to reduce spoilage at the source, and to speed up the flow of accurate production. Your operator knows beyond question that his work is accurate . . . he can check whenever he wishes.

Air-O-Limit Comparators are available to do a dozen gaging jobs. They will check for I.D. or O.D. limits, roundness, taper and bellmouth, giving instant, accurate readings that split "tenths."

They employ a simple principle—a spindle with two tiny opposite nozzles through which compressed air is forced. The amount of back pressure caused by limiting the discharge of air through the nozzles is registered on a precision pressure indicator calibrated in ten-thousandths of an inch.

Put air to work in your production gaging. Get the facts on how Air-O-Limit Comparators can speed up inspection, control accuracy on the job and reduce production costs. Ask for complete literature.

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fore citywide seniority becomes a possibility where it might not be one in other firms.

IN many respects, including the pay raise and the increased vacation allowances, the Briggs agreement parallels that reached with Chrysler Corp., which was completely released last week following its ratification by all locals.

The most notable aspect of this Chrysler contract came in accompanying letters exchanged between the company and the union. In one letter is found this significant sentence: "Both the corporation and the union recognize that high productivity in building cars and trucks of outstanding quality is to their interest, and it is their desire that prewar productivity be restored."

Although this sentiment in a letter probably does not have the effectiveness it would in the bargaining contract itself, the statement is notable. Also notable is the fact that the management is exclusively empowered to establish rates of production "on the basis of fairness and equity," and its decisions, while they may go through the bargaining procedure, do not wind up with the appeal board headed by an impartial umpire, as can be the case with interpretations of other portions of the bargaining contract.

Of significance also is the clause under which the union agrees not to permit strikes until all bargaining procedure has been exhausted and after negotiations have been continued for at least five days. This, obviously, is not strong by itself, but it becomes stronger when it is amplified by accompanying language setting forth that the corporation has the right to discipline any employee taking part in any violation of this agreement and that the union will not oppose discipline or discharge of leaders. Elsewhere in the contract are provisos that disciplinary measures taken against participants in illegal walkouts are the sole province of the company, although the appeal board may modify its decisions.

LOWDOWN: *Built on a standard* 1942 *Lincoln Zephyr chassis, this custom-built town car designed by Raymond Loewy, shown at the wheel, is* 6 *in. lower than standard cars without loss of headroom. Plexiglass roof over driver's seat can be removed in hot weather; exterior is in black and deep brown without bright chrome finish. Simplified body treatment eliminates projecting hardware.*

NOTWITHSTANDING the clearing of the labor skies in general, steel and GM being the exceptions, the auto industry is dragging along at the lowest production level at which it has reached since post-reconversion output got underway. This week saw virtually all Ford operations halted because of lack of steel in supplier plants. Chrysler plants were limping. Packard continued down because of lack of bearings, and has slashed its 1946 model projections in quite considerable degree. All in all Hudson and Studebaker are the only two factors in the industry operating at even a pretense of hoped-for rates. Simultaneously truck manufacturers, which have been the backbone of the automotive production totals since last summer, are drooping lower each week because of parts shortages accrued from the steel strike.

The production total of last week was estimated by Ward's Automotive Reports at 23,785 units, compared with 29,295 in the preceding week and with 20,960 last year at this time.

The agency observed that sudden plant closings of car manufacturers and suppliers alike, before basic metal stocks were completely exhausted — precautionary measures to maintain factories in operable condition—with feeder and assembly lines filled—will permit the almost immediate resumption of regular shop functions once the steel strikes are settled.

Koppers Co. Acquires Wailes Dove-Hermiston

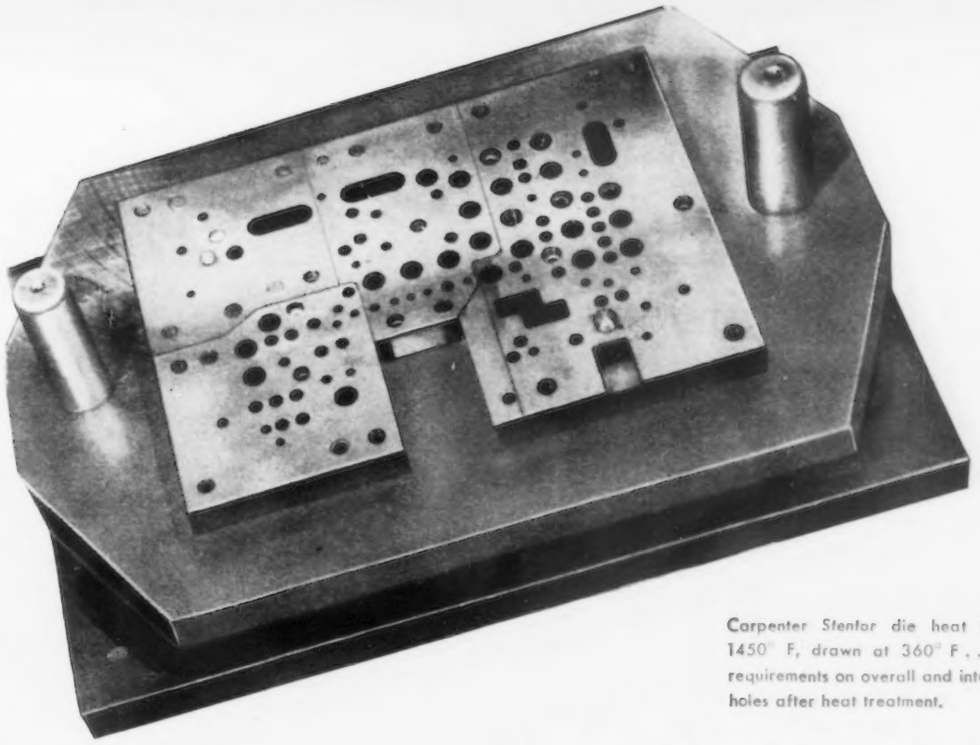
Pittsburgh

• • • **Acquisition of the** entire common stock of Wales Dove-Hermiston Corp., Westfield, N. J., by Koppers Co., Inc., Pittsburgh, was announced in a joint statement issued by J. N. Forker, Koppers vice-president, and Linden Stuart, president of the New Jersey company.

Wailes Dove-Hermiston Corp., is a manufacturer and contractor of bituminous coatings for the protection of iron and steel against corrosion. The latter company will continue to operate as a separate organization with the same management.

Bitumastic Enamel, the first product of the company, was developed in 1854 for the protection of certain internal areas of iron and steel ships against corrosion. In 1915 Bitumastic Enamel was first applied to a considerable mileage of oil pipelines in California. The company developed the modern type of water works enamel, which is sometimes referred to as the "plasticized" pitch type of coating. Also the rolling rig type of application of hot applied coating materials, such as Bitumastic, on the outside of large diameter natural gas pipelines.

The company also originated the modern method of applying hot coatings by the spinning process to the interior of iron and steel water pipe.



Carpenter *Stentor* die heat treated as recommended, at 1450° F, drawn at 360° F . . . easily met close tolerance requirements on overall and intermediate dimensions between holes after heat treatment.

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- forging heat
- normalizing heat
- annealing treatment
- hardening treatment
- drawing range
- tips on quenching
- furnace atmospheres

The slide chart is free to tool steel users, so for your copy, just drop us a note on your company letterhead.

Washington . . . L. W. MOFFETT

• Far reaching Supreme Court decision unexpectedly brings thousands of employers under wage-hour act . . . Surplus property consolidated into single disposal agency.

WASHINGTON — Expansion of employee coverage under the wage-hour law has reached a point where it does not seem unlikely that all classes of employees will eventually come under the provisions of the law. Literally thousands of employers, who were previously considered as being engaged in intrastate commerce only, have suddenly found themselves confronted with the provisions of the law under various court orders. This clearly indicates the need for enactment of a law to limit the time within which employee suits for "underpayments," liquidated damages and attorney fees may be obtained under the law. HR 2788 (THE IRON AGE, May 3, 1945, p. 106) favorably reported to the House, would establish a one-year statute of limitations affecting such suits and protect employers from retroactive liability if they have complied with an administrative practice or ruling.

The Supreme Court decision of Jan. 28, in the case of Roland Electrical Co. v. Walling, etc., illustrates the need for congressional action.

In this case, the court considered the question of whether employees of the company in Baltimore, whose primary work consisted of the repair of electric motors and other electrical equipment used and consumed by manufacturing companies only in the State of Maryland, were engaged in commerce or in the production of goods for commerce, and if so, whether they were exempted from the wage and hour provisions of the act under section 13(a) (2). That section provides that the wage and hour provisions of the law "shall not apply" to "any employee engaged in any retail or service establishment the greater part of whose selling or servicing is in intrastate commerce."

In concluding that equipment repair work was production of goods for commerce under the act, the court relied upon the language which states an employee is so engaged when working at "any process or occupation necessary to . . . production."

The court ruled that this definition does not require the employee to be employed in the production of an article which becomes the subject of commerce between the states, but that it is enough that the employee be employed; for example, in an occupation which is necessary to the production of a part of any other articles or subjects of commerce of any character which are produced for trade, commerce or transportation among the states.

The court also concluded that the exemptions applying to retail or service establishments were limited to sales and services "to ultimate consumers of them for personal rather than commercial purposes." In effect, therefore, the court combined the exemptions by applying dictionary and other definitions of "retail" to "service" the greater part of which "is in intrastate commerce."

This decision will have far-reaching effect. Practically every type of contractor performing "local" services for commercial companies engaged in production might be expected to be treated as covered by the act. Other workers apparently brought under the act by the decision are automobile mechanics who rebuild motors for other dealers or who perform work for commercial operators such as salesmen, and bus and truck operators.

SMILING JOHN: *Back in the fold of AFL, John L. Lewis is expected to have something to say about coal miners' wages in April. After being out of the limelight for so long, it is also expected that Mr. Lewis may have his own plans for future action and policies of the AFL. Steelmakers are still apprehensive over the possibility of a coal mine tieup in April, which could affect steel output.*

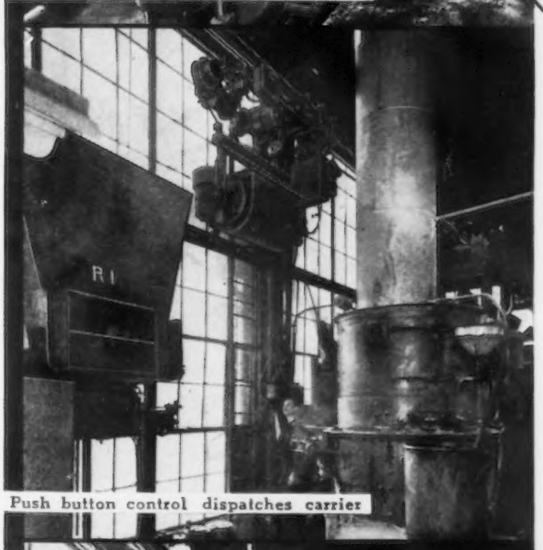
Moreover, the court's limited definition of "retail establishments" may now bring under the act's coverage large classes of retailers whose sales are clearly intrastate in nature. These would seem to include coal dealers who sell to commercial users, lumber and building material retailers who sell to building and other contractors, and all other retailers selling goods on the industrial or business market as distinguished from the individual consumer's market.

Any firm now brought under the coverage of the act that has not followed the practice of paying overtime in accordance with requirements of the wage-hour law may now be subjected to emloyee suits for underpayments, double damages and attorney fees, extending back to 1938 unless the period has been shortened by an applicable state statute of limitations.

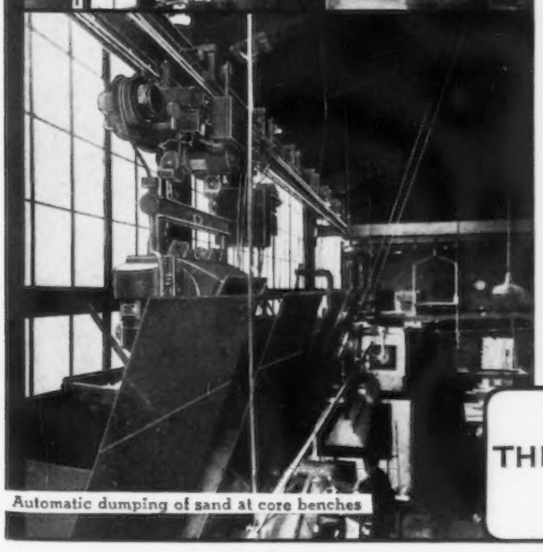
Moreover, this same class of em-

Automatic MONORAIL System

Loading bucket at speedmuller



Push button control dispatches carrier



Automatic dumping of sand at core benches

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This system operates as follows — Self-dumping bucket is lowered to floor at speedmuller to receive core sand. Operator raises bucket with twin hook hoist, sets the station selector and then presses starter button. The unit runs to the proper station and stops — bucket makes complete revolution dumping sand in hopper — whereupon the unit returns to loading station. All this operation occurs automatically, with no further attention from operator.

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ployers, as well as all others brought under the act, face the prospect of being required to readjust wage-rate schedules under proposed amendments to the law which would establish a 65¢ minimum wage immediately and a 75¢ minimum at a later date.

CONSOLIDATION of practically all surplus property disposal in one agency was made effective Jan. 31 when President Truman transferred the functions of the Surplus Property Administration to the War Assets Corp., headed by Lt. Gen. E. B. Gregory.

On Mar. 25 a War Assets Administration will be set up in the Office for Emergency Management to administer both the present surplus property disposal functions of the WAC and the former policy-making functions of SPA. General Gregory will be named head of the new agency subject to confirmation by the Senate.

Thus, for the first time, more than 90 pct of domestic surplus disposal will be in the hands of an independent agency responsible only for surplus disposal. The old method of assigning disposal problems to various existing agencies, such as RFC and the Commerce Dept., had long been the subject of criticism in Congress.

The WAA will be responsible for all surplus except food, ships and certain classes of real estate.

The two remaining problems that require attention before surplus property disposal can be accomplished in a businesslike manner are (1) the unworkable provisions of the Surplus Property Act, particularly the sections dealing with priorities, and (2) slow disposal methods.

The first of these requires congressional action. Several committees had investigated the problem last fall and amendment of the act seemed certain after the Christmas recess. However, with Congress bogged down on labor legislation, the troublesome FEPC bill, as well as other controversial measures, it is difficult to predict when action will be taken.

The second problem can be solved by General Gregory. Sales methods have required too much red tape and elaborate programming in the past. A high return to the government rather than speedy disposal of readily saleable goods was one of the cardinal principles of those in charge of consumer goods disposal.

It is reported that General Gregory has under consideration a return to a quicker method of selling. While this might result in a lower immediate return to the government, it would eliminate government expenditures for storage and other purposes. For example, the Ordnance Dept. plans to spend almost $75 million during the first six months of 1946 for storage, maintenance, handling and packaging of some of its surplus stocks. This amount is in addition to what must be spent by the disposal agency for advertising, additional packaging, etc., before eventual sale is made.

Auction sales were held by the Treasury Procurement Div. more than a year ago, as well as the RFC, but were so badly handled that a congressional investigation revealed the participation of former racketeers and penniless promoters, who had gained the confidence of government officials. The auction method was quickly discarded for most sales a short time later.

The transfer of SPA was made in accordance with the recommendation of former Surplus Property Administrator, W. Stuart Symington, who felt that there was no longer any need for a Surplus Property Administration, since the policy-making phase of the surplus property program has been substantially completed.

Mr. Symington has been appointed Assistant Secretary of War for Air, and resigned his SPA post as of Feb. 1.

THE BULL OF THE WOODS — BY J. R. WILLIAMS

HE WAS NAPPIN' AN' TH' TOOL DUG IN AN' BENT THAT JOB IN HIS MACHINE -- SO HE'S HIDIN' BEHIND TH' BENCH, TRYIN' TO STRAIGHTEN IT!
FINE WAY TO HIDE, AIN'T IT? THEY'LL THINK HE'S A LOAFER, SWINGIN' A THIRTY-POUND SLEDGE TO LOOK BUSY!
2-15 J.R.WILLIAMS
THE HIDE OUT
COPR. 1946 BY NEA SERVICE, INC. T. M. REG. U. S. PAT. OFF.

Seeks Lease on RFC Plant

Monroe, Mich.

• • • **Monroe Auto Equipment** Co. is seeking a lease and purchase option on the plant here formerly operated by the Aluminum Co. of America for the Reconstruction Finance Corp.

The Monroe company hopes to use the plant to produce the new torsion bar suspension it is manufacturing for Kaiser-Frazer Corp. for installation on the Kaiser automobile. The plant involved is that owned by the Republic Steel Corp. until 1942, when RFC bought it, equipped it for production of forged aluminum cylinder heads for aircraft engines, and assigned it to Alcoa for operation.

THIS Sheffield Precisionaire which reminded the purchaser of a piccolo, checks a tapered bore at ten points. Inside the spindle a plunger type valve directs the air flow through one pair of diametrically opposed orifices at a time, thus making it possible to check each of the ten points in sequence.

The tolerance markers on the base instrument are set to the maximum and minimum master chambers (illustrated). In inspecting the work part the spindle is inserted into the bore and each of the ten points checked progressively. If the indicator remains within the length of tube between the markers throughout the inspection, the part is acceptable. If not, any error is immediately located.

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West Coast . . .

OSGOOD MURDOCK

• Motordom's two newest top executives meet for first time . . . Kaiser shows new plane . . . Ford is winning the West . . . Seattle is optimistic . . . Another midget car makes appearance.

SAN FRANCISCO—The son of a shoe cobbler who has battled his way to international fame as an industrialist and the son of one of the nation's wealthiest men who gives promise of overcoming that handicap as he heads up one of the world's richest industries, met here last week for the first time through the coincidence of traveling west on the same train.

Henry J. Kaiser, returning to his home office in Oakland, and Henry Ford II, on a visit to the holdings of his company in the West, reportedly discussed everything of national importance on the trip, but denied that there was any business significance to their choice of the same train west. Since Mr. Kaiser is chairman of the board of the Kaiser-Frazer Corp. which is soon to start production of automobiles and Mr. Ford is president of Ford Motor Co. it is natural that some questions might arise.

After the photographers had made the most of the opportunity to catch the two Henrys and their wives, Mr. and Mrs. Ford went directly to San Francisco and Mr. Kaiser lured the press representatives to the Oakland airport for the first public demonstration of his latest aircraft—the Kaiser-Hammond Air Car.

The new plane looks like an abbreviated Lightning in that it has a twin fuselage, but the comparison ends there. It is a pusher type, with the propeller and engine mounted high between the tail portions of the fuselage and behind the pilot, and passenger compartment which will accommodate five persons. Equipped with a 220 hp Lycoming engine, it has a maximum speed of 150 mph, cruising speed of 130 mph and cruising range of 600 miles, it is claimed. Gross weight is 3000 lb, empty weight 1800 lb, it is 40 ft long and has a wind spread of 28 ft. Built under the direction of Dean Hammond, who designed the Stearman-Hammond which won a national safety award, the new airplane is said to incorporate even more safety features than its predecessors and to be stall-proof and spin proof.

Asked how soon the plane would be put in production Mr. Kaiser stated that plans were uncertain but that he "hoped it would be soon." The body of the present model is made of sheet aluminum with fabric wing covers, but production models will be either all or part aluminum, magnesium or possibly molded glass fiber, it was stated.

After a short taxiing demonstration with Mr. Kaiser at the controls, the ship was flown by test pilot James M. Nissen. Considerable stress was placed on its ease of handling and simplicity of controls which consists of a wheel, throttle and foot brake. There is no rudder.

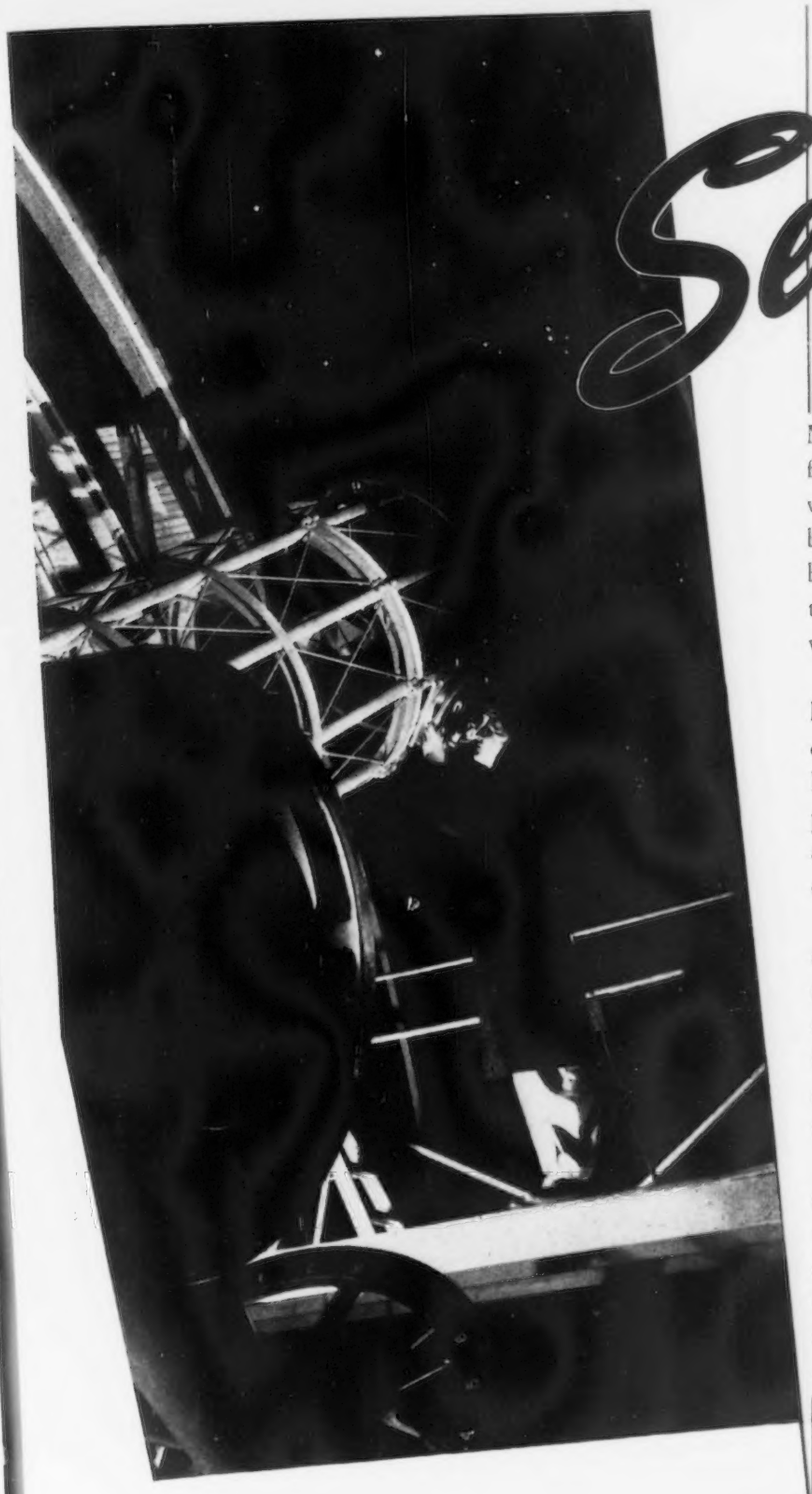
Optimistic over the outcome of the Kaiser-Frazer Corp. offer to lease two aluminum plants in the Spokane, Wash. district, Mr. Kaiser stated that he hoped to use a large part of the production of the Trentwood rolling mills in bodies for Kaiser and Frazer automobiles. He stated this plant could produce enough sheets to turn out 3000 bodies a day.

Under the terms to be approved by RFC Mr. Kaiser will make a $350,000 token down payment on the two aluminum plants and rent on the Trentwood rolling mill will be $250,000 or five pct of net sales, whichever is the higher. The lease on the Mead reduction works will be four pct of production costs the first year and an additional one pct per year until eight pct is reached. When operated by Aluminum Co. of America during the war, the Trentwood mills had a capacity of 120,000 short tons a year.

CONJECTURE: *Whether or not there is any significance to it, the conversation between Henry Kaiser (left) and Henry Ford, II (right), after both arrived at Oakland, Calif. on the same train recently, will probably keep the rumor factory busy for awhile.*

Production of the Kaiser car only on the West Coast is anticipated this summer in former Douglas plants at Long Beach at the rate of 400 cars a day, according to a recent statement of Henry Kaiser, Jr. Mr. Kaiser, Sr., indicated that production of both cars will be underway at Willow Run by late spring or early summer. He further stated that there will not be a West Coast preview of the cars as held recently in new York because: "We are anxious to get into production and the materials and men which would be involved in such a showing are more sorely needed in the plants. We are convinced of the public's acceptance of the automobiles, we are going all out to make them." He then cited the fact that the New York show produced orders for more than 10,000 automobiles as evidence of demand.

MR. FORD'S West Coast visit wasn't made any brighter by the prospect that his assembly



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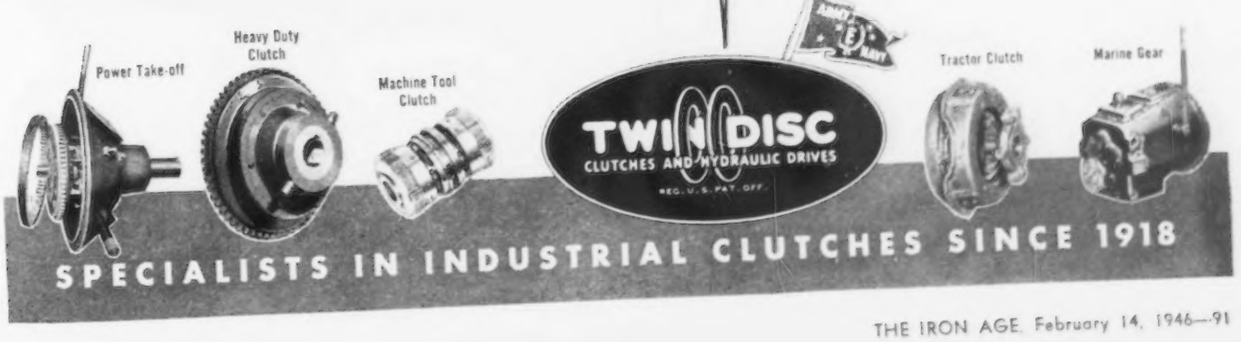

plants here might be closed up because of the steel shortage. Plant superintendents were watching dwindling inventories of parts and knew just what Mr. Ford meant when, in a talk before the Commonwealth Club of California last Friday, he said, "There are some days on which the mailman brings us more from our suppliers than the railroads do."

Mr. Ford's talk struck a responsive chord in the minds of many in his audience who are faced with labor slow downs, increased material costs, higher overhead and price restrictions such as were frankly discussed by the young executive. Without any table pounding or invective, Mr. Ford related how one model of the Ford increased in production cost from $512 in 1941 to $1041.26 in 1945 and that the company had been authorized by the OPA to sell that car for $728.

Making is clear that he was not attacking government controls, nor condemning labor, Mr. Ford stressed the belief that the solution to many problems of the day lay in honest, hard work and added: "We must use our greatest ingenuity and effort as manufacturers to manufacture in the face of very great obstacles. We must use our great ingenuity and effort and effort as labor leaders to meet the problem of a falling productivity rate among workers. We must use our greatest ingenuity and effort as government officials and legislators to get us clear of unnecessary entanglements and out in the open again."

Western manufacturers were quick to respond to Mr. Ford's enthusiasm and personality and the feeling was generally expressed that he was a worthy successor to his father and grandfather. That he has already captured the imagination of businessmen of this area is indicated by the near record turnout at the meeting.

* * *

SEATTLE—Looking ahead to the day when tranquillity prevails on the labor front, the City Council has set up an industrial commission for the purpose of attracting additional industries to this area. To finance the project at an estimated cost of $35,000 a year, contributions will be made by the city's general fund, the water and light funds, and the transit systems funds. Top job on the commission is to be that of Industrial Director at a salary of $6500 a year.

All has been quiet on the strike front here with ample evidence of "let the East settle the mess" attitude. Pickets at Bethlehem Pacific Coast Steel Corp. and Northwest Steel Rolling Mills, Inc. plants have but routine duty.

Machinists, boilermakers, foundrymen, and blacksmiths are still at work but strike talk continues as it has for the past two months. There are meetings and plenty of talk, but nothing seems to be accomplished. Union leaders apparently are aware that with most of the steel fabricating shops of the Washington Metal Trades Council facing shutdowns because of a lack of steel this is not a propitious time to strike.

There is talk of the Todd-Pacific yards making an arrangement with the Navy for an exchange of interests. It is reported that R. J. Lamont, president of the Todd-Pacific organization is negotiating with the Navy to transfer all interests in the Tacoma yard to the government and leave Todd in complete control of the Seattle drydocks. A settlement is looked for by April. The Todd-Pacific yard in Seattle operated under a government lease has enough work ahead to keep it busy and in full operation through June of this year and repair work may run into a two or three year operation, it is stated.

* * *

SAN DIEGO—Another David comes forth to do battle with the Goliaths of the automotive industry. Bobbi-Motor Car Corp., has announced its new Bobbi-Kar—a small car said to have all the features of a standard size automobile and made to sell in the $500 to $600 class. First model produced is a convertible coupe which will be followed by a two-door sedan, a package car and a station wagon, according to J. S. Liefeld, executive vice-president and general manager of the company.

Weighing approximately 1000 lb, the Bobbi-Kar is said to average 40 miles to the gallon of gasoline through its 25 hp, four cylinder, water cooled Hercules engine mounted in the rear. Engine and drive assembly are unified and can be replaced as a unit in 10 min, according to factory representatives. Other features are torsilastic independent four-wheel suspension, oversize four-wheel hydraulic brakes, synchromesh transmission; an 8-in. dry plate clutch; full floating rear axle.

The convertible coupe has a one-piece steel top which can be removed by latches above the windshield and at the back deckline. When removed, the top can be stowed in the front end package compartment. An all-steel body is surrounded by steel supports and steel stamping is used extensively in the chassis.

Overall length of the car is 132 in. wheelbase 80 in., turning radius 13 ft 5 in., tread 42 in., seat width 43 in., tires 4.50 x 12, maximum speed 60 to 65 mph, tubular steel X-trussed frame.

Production is contemplated in two converted aircraft plants at Chula Vista and National City. It is reported that by February, 1947 these cars will be produced at the rate of 5000 per month. The company management reports thousands of inquiries from all parts of the world. National distribution is planned.

* * *

Solar Aircraft Co., which during the war was an important manufacturer of aircraft manifolds, has diversified its production by turning to the making of castings, stainless steel caskets, steel photographic equipment and midget racing cars.

While continuing to produce aircraft exhaust manifolds, Solar is entering new fields to utilize fully their facilities. Specializing in fabrication of alloys noted for their heat and corrosion resistance, the company has been looking about for new products. Last year it acquired a subsidiary in Des Moines, Iowa, which is now known as the Solar Precision Castings, which assures a source of parts for future operations. The Hubbard Casket Co. of this city was recently taken over for the manufacture and national distribution of stainless steel caskets. The most recent acquisition is the Fonda Film Processing Machinery Co. of Los Angeles which was taken over last week and which will continue to turn out and sell photographic developing machines. According to Edmund T. Price, president, the company now employs 2000 persons, or about half as many as during the war, and he hopes to increase that number as new products are added.

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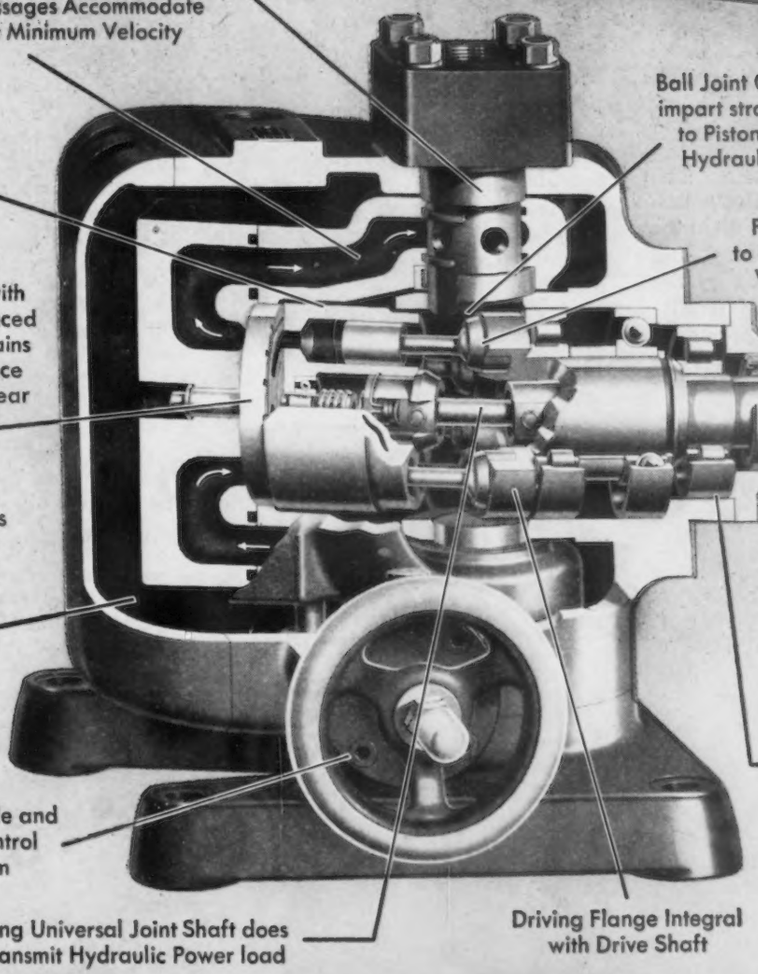
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European Letter . . . JACK R. HIGHT

• British authorities using on-site sales to implement machine tool surplus sales . . . Buyers rush into queues for scarce items.

BURGHFIELD, BERKS, ENGLAND—"Site Sales" disposing of surplus machine tools directly from factory and warehouses are being used by the British Ministry of Supply & Aircraft Production to supplement sales from central inventories. Held periodically wherever large concentrations of tools are available, the special sales cater to purchasers who wish to inspect and buy direct from the site.

At a recent sale held here at the Ministry of Supply Depot, about 240 tools were sold in a single day's operation, from a total on display of about 950. Actually only about 380 of the tools were on sale for the first offering, as the remainder had been on display at earlier sales and are of the types more difficult to sell. The average price amounts to about $1200 per machine, which would bring the value of the sales for the day to about $262,000.

Future sales of a similar nature are planned to take place at factories where the quantity of tools available is sufficient to justify setting up a temporary disposal center.

The tools being offered were in use during the war and are being sold where they lie to avoid extra haulage to depots. While the sales are normally concentrated in the first day of opening they remain open for several weeks until most of the machines are sold and those remaining are taken into various stores and sold through the permanent disposal centers.

The depot at Burghfield is the only permanent sale site in operation at the present, but there are in existence plans to open others. The stock at the depot here now totals between 1500 and 2000, but many of these are new arrivals, not yet ready for sale. British Machine Tool Disposal authorities are taking extra pains to clean the tools as much as possible so that they present the best possible appearance.

The machine tool sale depot is located in what was an ordnance factory during the war. The dispersal of the machines in six individual buildings makes the selling arrangement slightly more complex than they might be in a single large open factory, but adaptations have been made to render the site as satisfactory as possible.

At this permanent sale site the average turnover at present is about 50 tools per day, counting both new arrivals and sold tools actually shipped. Although the policy of the M.T.D. is to incur no responsibility for shipment of tools, the depot does assist in the loading operations at the purchaser's risk. The physical limitations of the numbers of cranes available for movement, and the number of towing gangs that can be used in a single display room are the limiting factors in the movement.

Great emphasis is put in the arrangements of special "on-site" sales to give the prospective buyer immediate information as to whether his bid has been successful. Thus, when the manufacturer or dealer acting for him places a bid, it usually takes about 20 min for him to find out if there were any previous bids and to get a tentative acceptance for it.

This procedure is made possible by making the tools in the showrooms available only to buyers at the site. Thus, although the stocks of most storage depots are inventoried and are listed for sale in a number of regional disposal centers, the 900 odd tools at this Burghfield base are not included.

SPECIAL attention is being paid by the machine tool disposal experts to make certain that all potential buyers get equal opportunity to purchase all tools, and various systems are in use to thwart the enthusiasm of overeager would-be buyers. The system in use here is to put the prices

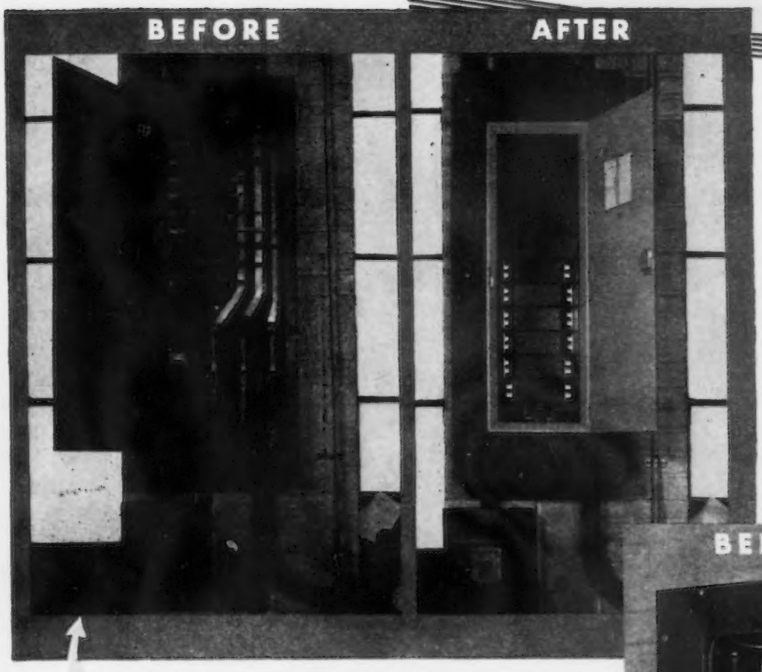
UNPRECEDENTED DEMAND: *British motorcycles of all kinds are expected to be produced at the rate of* 1,000,000 *for British consumption and* 1,500,000 *for export during the next* 12 *months. An all-time record order from the United States has been placed with one British firm in Birmingham for* 5000 *motorcyclettes.*

HERE IS A

CONVERSION PLAN

THAT REALLY PAYS OUT

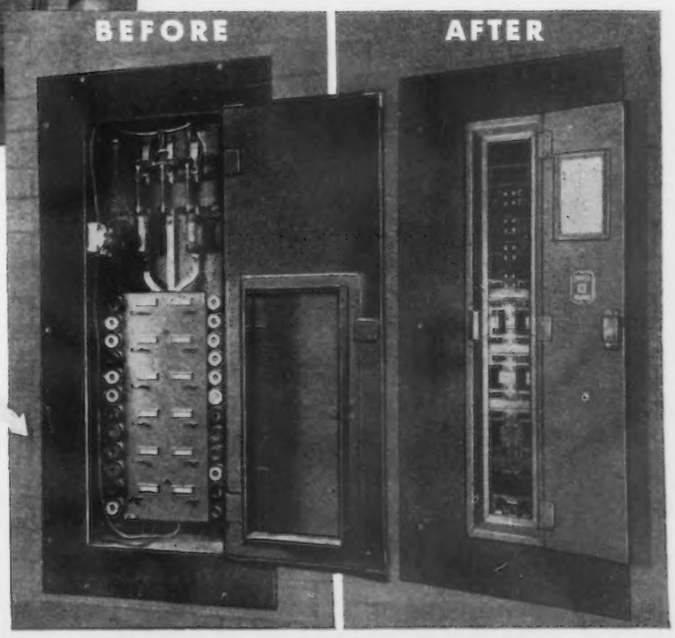
• *Here are two typical examples of conversions which involved a minimum of installation time and labor and brought the following results:*



1. *Increased panelboard capacities and added modern circuit breaker convenience and protection.*
2. *Utilized existing boxes and conduit.*
3. *Conserved power previously lost through overloads.*
4. *Eliminated the replacement of branch circuit switches and fuse clips due to excessive heating.*

300% MORE CAPACITY . . .

From three to twelve 3-pole circuits and provision for eight more whenever needed. Existing box was used and no conduits added.



138½% MORE CAPACITY . . .

From 13 to 31 single and two-pole circuits. In addition, a needed 3-wire circuit was provided at bottom of panel. A speedy and economical changeover.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

on the machines only after the center has closed to the public on the day previous to the special sale.

On the sale day, the gates open at 8:30 to handle the routine of issuing passes to the buyers, but the display rooms are not opened until 10:00 at which time the sale officially begins. At that time, the queued-up buyers go into the display room, copy off the price of the tools in which they are interested, and then proceed to the central disposals office.

Another carefully supervised queue forms there, and the buyers are allowed into the office one at a time to deposit their offers to buy. Each form is time-stamped, a visible card-file system shows each tool for sale, in green if still available, and white if already sold. Clerks handle the offer, crossing the tool off if previously sold, and checking it if the offer is tentatively accepted. A messenger takes the notification form back to the buyer's headquarters, which is a centrally located room set up for their comfort and convenience.

While the buyer is being notified, another messenger is carrying the notification of sale to the display room, where the machine tool that has been sold is marked with a large "X" in red paint, to prevent later duplication of offers to purchase. The system is set up so that on visiting the display room 15 min after the sales room, workmen were already painting the first X's on machines which had been sold that morning.

There is keen competition to secure machines in short supply and purchasers and merchants queue long before the sale commences and run to the machines in their eagerness to make the first offer.

At a recent sale over 100 tools were sold in the first hour of operation. Some eager dealers have worked out "systems" to get as many of the desirable tools as possible, including the use of stand-ins in the queues so that as soon as the price is obtained the offer can be passed to a compatriot who is in a good position in the queue. The disposal authorities have had good success in stamping out such shady practices, so that the overall reaction to the management of the sales on the part of the trade is very good.

It is planned for the large sales to be held in the future that all of the tools will be on display for the first time at the hour of the sale opening, and no advance prospecting will be permitted. Thus, where in the recent sale held here most of the buyers have decided in advance just what they wanted to bid on and had only to go to the machine and get the price, at the large sales they will have the entire job to do after the sale opens.

THE same pricing policy is adhered to for the sales on site as is used for the inventory-arranged sales described previously (see THE IRON AGE, Jan. 24, p. 84). All machine tools are priced in advance by the Machine Tool Disposals authorities, and no variation from the indicated price is accepted. The general quality of the tools has become so well established in the trade that the M.T.D. estimate of the condition reflected by the quoted price is accepted virtually as gospel. The only frequently heard suggestion from buyers is that due to the nature of war work, many of the tools are noticeably worn at one specific setting, where they may have been used almost exclusively throughout their wartime life.

The sales organization set up at these site sales employ a relatively small staff in comparison with the number of visitors and the machines sold.

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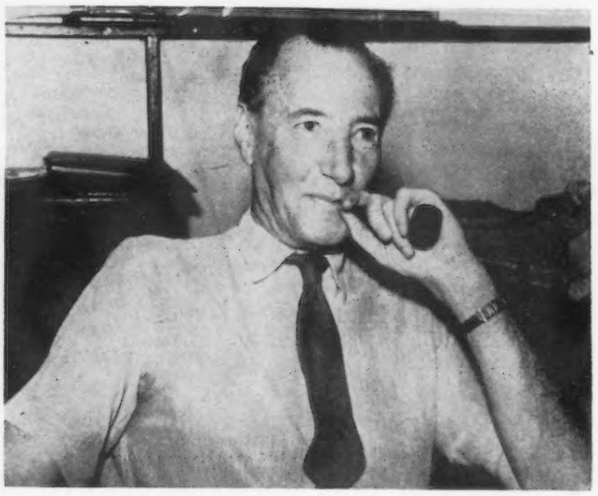

NEW AMBASSADOR: *Sir Archibald Clark Kerr who has been named new British Ambassador to the United States to succeed the Earl of Halifax who retires on May 1. Clark, 64-year-old Scottish-born diplomat, has served in many important capacities, chiefly as former British Ambassador to Russia.*

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Baldwin Ships 1552 Locomotives in 1944

Philadelphia

• • • **During 1944,** the Baldwin Locomotive Works received orders for 404 steam locomotives and completed and shipped 1200, according to the company's annual report which had been delayed because of renegotiation of the company's contracts. Orders for 253 diesel electric switching locomotives were received and 352 were shipped.

Total unfilled orders on the company's books at the beginning of the year 1944 were approximately $250 million. At the end of the year this total declined to $106,002,204.

The volume of total billings of the company and its wholly owned subsidiaries for the year 1944 was $210,575,974 compared with billings of $221,545,903 for the previous year, a decrease of 5 pct. Total number of all employees declined from 20,095 on Jan. 1, 1944 to 18,361 on Dec. 31. Wages and salaries paid in 1944 was $60,950,415; cost of materials and supplies purchased was $111,887,520 and provision for taxes amounted to $18,671,087.

Construction Rate Climbs

Buffalo

• • • **The City Div. of Buildings** reports January building permits totaled $1,067,225 for 187 projects, compared with $56,170 for 69 permits in January, 1945.

Mahon Fabricated WELDMENTS

. . . a Plus Value in APPEARANCE

Mahon design engineers and the Mahon plant—modern though it is in every respect—with every facility to insure precision in fabrication and thoroughness in treating and inspection, are not alone responsible for the finished appearance of massive weldments such as the one illustrated here . . . the technique and skill of Mahon craftsmen shows up and speaks volumes in the finished product. This is a plus value of which the Mahon organization is justly proud, and are pleased to pass along to you.

Address Inquiries to STEEL PLATE DIVISION

THE R. C. MAHON COMPANY

Home Office and Plant, Detroit 11, Michigan
Western Sales Division, Chicago 4, Illinois

Engineers and Fabricators of Welded Steel Machine Bases and Frames, and Many Other Welded Steel Products.

MAHON

PERSONALS

o o o

• **F. J. Staroba,** formerly with the Milwaukee office of Carboloy Co., Inc., has been transferred to the Chicago office, as has **E. Monacelli,** who was formerly located in St. Louis. **C. W. Powell,** formerly of the Carboloy general sales dept., is replacing Mr. Monacelli at St. Louis. **R. B. Lewis,** service engineer at the home office in Detroit, has been transferred to Chicago.

• **R. David Thomas, Jr.,** director of research and engineering of Arcos Corp., Philadelphia, since 1940, has been elected vice-president of the company.

• **G. B. Evans,** general superintendent of Wagner Electric Corp., St. Louis, since 1921, has been promoted to plant manager. **C. W. Hesse** succeeds Mr. Evans. Mr. Hesse was plant engineer of Wagner Electric for 15 yr, and in 1942 became assistant general superintendent, the position he held until his recent promotion to general superintendent. **W. A. Okenfuss** has been promoted to assistant general superintendent.

• **K. U. Wirtz,** formerly assistant secretary of the Electric Furnace Co., Salem, Ohio, has been promoted to the position of executive vice-president. He joined the organization in 1927 as an erection engineer, and served in various capacities including chief estimator and sales engineer before being advanced to assistant secretary in 1935. **C. L. West,** vice-president who has been connected with the company since 1930, now assumes complete charge of all sales and sales engineering. **C. H. Vaughan** has been appointed vice-president.

• **Forrest M. Luckett** has been appointed branch manager of the Organic Chemicals Div. office of Monsanto Chemical Co. in Cincinnati. He has been associated with Monsanto since 1924 when he joined the service depts.

• **R. C. Evans** has been placed in charge of the packaging materials sales dept. recently established in the Plastics Div. of Monsanto Chemical Co. Since 1944, he has been an assistant sales manager in charge of sheet vinyl resin sales.

• **Ira S. Latimer** has been appointed district sales manager in charge of the Chicago office of Rotary Electric Steel Co. He formerly worked out of the Detroit sales office.

• **Edward L. Dull** has been appointed Chicago district sales manager for Pittsburgh Steel Co., Pittsburgh. Mr. Dull began his business career in the operating dept. of Jones & Laughlin Steel Corp. in 1927 and later was transferred to the sales dept. Since 1937 he has been sales representative in the Chicago area for Babcock and Wilcox Tube Co.

• **A. L. Ralston** has been appointed manager of roll sales of Lewis Foundry & Machine Div., Blaw-Knox Co., Pittsburgh. Mr. Ralston has been with the Lewis Foundry & Machine Div. since 1927, first as salesman, then as assistant manager of roll sales.

• **L. N. Zimmerman, Howard B. Weeks** and **Gale B. Robinson** have been appointed district representatives of Iron Fireman Mfg. Co., in the midwest and central division. Mr. Zimmerman will cover southeastern Michigan and northwestern Ohio with headquarters in Detroit. Mr. Weeks will have headquarters in Decatur, Ill. Mr. Robinson will have headquarters in Connersville, Ind.

• **William L. Platt** has been appointed sales representative for the Columbia Chemical Div. of the Pittsburgh Plate Glass Co., and will be located at the company's offices in Boston. Prior to his appointment to the Columbia Chemical Div. in 1930, he was associated with the company's Glass Div.

• **R. H. Money,** refrigeration expert, has joined the Parts Div. of the Reynolds Metals Co. as an advisor. He will be stationed in Louisville, Ky. Prior to joining Reynolds, Mr. Money was for 15 yr with the Crosley Corp. in Cincinnati.

• **J. Raymond Smith** has been appointed district manager of Baltimore for the Edgcomb Steel Co. Mr. Smith recently resigned as assistant to the general sales manager of Rustless Iron & Steel Corp. Prior to his connection with Rustless, he had been with the Eastern Stainless Steel Corp. for 22 yr.

• **N. F. Vanderlipp,** aircraft manufacturing executive, has joined Kellett Aircraft Corp., Upper Darby, Pa., as works manager responsible to president W. Wallace Kellett, in charge of all production activities. Mr. Vanderlipp has been a member of the Curtiss-Wright organization for 2½ yr as executive engineer, general manager of the Buffalo airplane plants and factory manager of the Columbus plant. He also has been president and general manager of Bellanca Aircraft Corp. and continues as a member of the board of directors of Bellanca.

• **L. E. Briggs,** veteran Ford Motor Co. employee, Dearborn, Mich., has been appointed general auditor for the company.

• **O. P. Donohue** has been promoted to the sales promotion staff of the Allis-Chalmers Mfg. Co., Milwaukee. He will specialize in the heating, ventilating and air-conditioning industries. Prior to his service in the Navy, Mr. Donohue joined Allis-Chalmers in 1941 and has served in the company's product depts., engaged principally in serving the heating and ventilating fields. **Arno A. Schubert** has joined the company and will engage in sales promotion in the machine tool industries.

• **John Quinn,** manager of the Canton, Ohio, plant and a director of United Engineering & Foundry Co., Pittsburgh, has been elected chairman of the board of directors of its subsidiary, Adamson United Co., Akron, Ohio.

• **Thomas P. Moran** has been appointed Detroit district manager of Precision Welder & Machine Co. of Cincinnati. Mr. Moran was welding engineer for over 10 yr at Ternstedt Mfg. Div. of Fisher Body Corp.

• **Arthur H. Starrett,** formerly vice-president, has been made president of the L. S. Starrett Co., succeeding **David Findlay,** retired. Mr. Findlay was with the concern since 1891.

• **Thomas H. Dawson, Jr.,** since 1940 manager of the Grinnell Co., Inc., Atlanta sales dept., has been made manager of supply sales dept. of the Providence territory which covers New England and eastern New York state. Before joining the Grinnell outfit, he was with Crane Co.

• **Lavette C. Teague,** assistant purchasing agent since 1936, has been appointed purchasing agent of the Tennessee Coal, Iron & Railroad Co., Birmingham, succeeding **Richard Shively.** Mr. Shively has retired after being associated with the Tennessee Co. for 42 yr, the last 10 as purchasing agent. With Mr. Teague's appointment, **Alfred J. Cox** and **James B. Noel** will be assistant purchasing agents and **Clarence E. Michaels** will be assistant to the purchasing agent.

• **C. S. Munson, Jr.,** after 4½ yr of active duty with the Navy, has returned to the Vanadium Corp. of America, New York, where he has been appointed assistant to general manager of sales.

• **Robert B. McColl** has been elected a member of the board of directors of General Steel Castings Corp., Eddystone, Pa., to take the place of **William C. Dickerman** who resigned. Mr. McColl is president of American Locomotive Co.

• **Fred Habegger** has been appointed manager of advertising and sales promotion of the Bryant Heater Co., Cleveland.

• **Robert F. Davis** has been promoted from director of production to vice-president and general manager of Jordanoff Corp., New York.

• **H. D. Kelsey** has been appointed managing engineer of the General Electric Co.'s new Aircraft Gas Turbine Div. at Lynn, Mass., after serving in numerous important engineering positions with the company for 25 yr.

E. P. TURNER (left) and LEROY J. FRALICK (right), vice-presidents, Midland Steel Products Co.

• **E. P. Turner** and **LeRoy J. Fralick** have been elected vice-presidents of the Midland Steel Products Co., Cleveland. Mr. Turner, who joined the Detroit Pressed Steel Co. as a member of its Salvage Div. in 1922, came into the Midland organization when it acquired the Detroit company in 1924. He is now manager of the Detroit Pressed Steel Div. Mr. Fralick was with the old Hydraulic Pressed Steel Co., now the Cleveland division of Truscon Steel Co., from 1912 until 1924. He was assistant sales manager when he left to join the sales dept. of Midland at the time it was organized. Mr. Fralick was named assistant sales manager with offices in Detroit in 1928 and has been sales manager of the company since 1932.

• **John D. Mann,** formerly director of automotive rationing for the OPA, has rejoined the B. F. Goodrich Co., Akron, Ohio.

• **E. C. Shingleton** has rejoined the advertising and sales promotion dept. of the B. F. Goodrich Co., Akron, Ohio, after nearly 42 months in the armed services.

• **Frank M. Aldridge** has been elected president and treasurer of the J. W. Kelley Co., Cleveland, succeeding **James W. Kelley** who becomes chairman of the board of directors.

• **Louis E. Mohr** has been elected vice-president of John Mohr & Sons, Chicago, heavy steel plate fabricators, engineers and machinists. For the past 12 yr he was associated with Johns-Manville Sales Corp. as sales engineer in the Steel Products Div. at Chicago.

• **Joseph M. Garver** has been appointed plant superintendent of the Ziegler Steel Service Co., Los Angeles. Mr. Garver was formerly associated with Carnegie-Illinois Steel Corp., American Rolling Mills, and Columbia Steel Co.

• **Richard M. Johnson** has been appointed to the position of assistant sales manager of the Chandler-Evans Corp. of West Hartford, Conn., a subsidiary of the Niles-Bement-Pond Co. He joined the Chandler-Evans organization in Dayton in 1942, and successively held the posts of employment manager, production manager and assistant factory manager. During the past few months he has been in charge of the plant at Dayton, the activities of which have now been transferred to West Hartford.

• **Philip R. Mallory** has been elected chairman of the board and **Joseph E. Cain,** president of P. R. Mallory & Co., Inc., Indianapolis. Mr. Cain has been associated with the Mallory Co. for 18 yr, and has served as credit manager, treasurer and as vice-president and executive vice-president.

• **D. J. Mosshart** has been appointed engineering manager of the stoker dept. of Westinghouse Electric Corp.'s Steam Div. at Philadelphia. He succeeds **R. A. Foresman,** who had been on extended service for several months prior to his retirement.

• **Col. John E. Getzen** has become associated with Harry G. Mouat, Birmingham, manufacturers' representative for industrial equipment. Before returning to civilian life, Col. Getzen was chief of the Birmingham ordnance district.

• **John R. Hoover,** formerly general sales manager of plastic materials, has been elected vice-president in charge of sales of the B. F. Goodrich Chemical Co., Cleveland. **Allyn I. Brandt,** formerly general sales manager of rubber chemicals, becomes general sales manager of all chemical company products sold domestically.

• **H. W. Deuker** has been made works manager of the Cincinnati plants of the Manufacturing Div. of Crosley Corp. **O. E. Norberg** has been promoted to the position of manager of refrigeration and appliance engineering in the Manufacturing Div.

• **Ralph E. Lovdal** has been appointed manager of the Northern district of the Westinghouse Electric Supply Co. with headquarters in Milwaukee. He succeeds **Roy L. Brown** who has been transferred to New York City as manager of the Eastern district. **Clarence G. Ward** has been appointed manager of the Peoria, Ill., branch of the company. **F. D. Phillips,** whom Mr. Ward succeeds, has retired.

• **Donald Carr,** recently discharged from the Army, has been appointed sales manager in charge of hoist and trolley sales by Conco Engineering Works, Mendota, Ill. Mr. Carr was employed by Conco at the time of his entry into the service 4½ yr ago.

• **Michael Leyava** has joined the James Flett organization as manager of the Cleveland office. Mr. Leyava will assume his new post Feb. 28. He has recently been released from the Army where he served as captain in the salvage and scrap section, Industrial Div., office of the chief of ordnance.

ALLEN B. WILLIAMS, president Aluminum Ore Co.

• **Allen B. Williams** has been made president of the Aluminum Ore Co., East St. Louis, to succeed **Charles B. Fox** who has retired from active business. The Aluminum Ore Co. is a subsidiary of Aluminum Co. of America. Mr. Williams assumes his new duties as president of the company after a long career in both the sales and manufacturing depts. of Aluminum Co. of America. He began his career nearly 34 yr ago, when he entered the apprentice training course at the New Kensington, Pa. works. In 1942 he became vice-president of Aluminum Ore Co. and first assistant to Mr. Fox, with headquarters in St. Louis.

• **Carlos E. Harrington** has been appointed chief engineer in full charge of design, research and development work of Winfield H. Smith, Inc., Springville, N. Y.

• **A. C. Griffith** has been appointed sales manager of Standard Brake Shoe & Foundry Co. with headquarters at the general offices in Pine Bluff, Ark.

• **L. E. Biggie** has been appointed regional manager, west coast area sales office of the Putnam Tool Co. of Detroit. His headquarters will be in Glendale, Calif. During the past 15 yr he has been associated with Ford Motor Co., Detroit Broach Co., and Robert H. Clark Co.

• **Stephen D. Garst** has joined the staff of **Bjorksten Laboratories,** Chicago, as a chemical metallurgist. An employee of the Federal Government and Socony Vacuum Oil Co. as a chemical engineer and metallurgist for several years, he most recently was connected with the Dodge Chicago plant of Chrysler Corp.

• **Jack Green** has been appointed sales manager of the Welding Fittings Div. of Tube Turns, Inc., Louisville, and is succeeded as assistant sales manager of the division by **Tom Pike.**

• **Ralph H. Hopp** has been appointed librarian at Battelle Memorial Institute, Columbus, Ohio.

• **Lachlan W. MacLean** has been appointed Boston sales office manager of the Dampney Co. of America.

• **Albert Zeisel,** former midwestern regional sales manager, has been appointed assistant in charge of sales to R. D. Wasserman, founder and president of the Eutectic Welding Alloys Co., New York.

• **J. E. Weldy,** assistant to the vice-president of Carboloy Co., Inc., Detroit, for the past 3 yr, has been appointed manager of distributor sales. **Harry Crump,** recently assistant to the vice-president, has been advanced to the position of chief tool sales engineer and will be in direct charge of all sales engineering of Carboloy cutting tools and wear parts. **G. M. Chandler,** Carboloy Co. sales engineer in the Chicago district since 1937, has been appointed assistant to the vice-president in charge of sales. In his new capacity, Mr. Chandler, who has been with the company for the past 10 yr, will devote a major part of his time to sales analysis and market research work in the fields of carbide tools, dies, and wear resistant parts.

• **Wyman Eaton** has retired as president of Freyn Engineering Co., Chicago. He will continue as a director of the company. **L. T. Shorley** has been elected president and treasurer.

• **H. C. Bostwick** has been appointed to represent the Drever Co., Philadelphia, in the area including western Pennsylvania, western New York, and Ohio. He will make his headquarters at Shaker Heights, Ohio. Mr. Bostwick has 18 yr experience in the industrial furnace field and previous to that had spent 5 yr in the steel industry.

• **Dr. Daniel S. Eppelsheimer,** heretofore serving as acting director of the engineering experiment station of the University of New Hampshire, has become associated with Metal Hydrides Inc., Beverly, Mass., as sales manager and chief physical metallurgist.

• **E. E. Ames** will retire from the General Box Co., Chicago, on July 1. Mr. Ames has long served the company in the capacity of director of sales and is one of the most prominent men in the packaging industry. **N. A. Fowler,** present vice-president and director of research, will succeed Mr. Ames and serve as director of sales and research.

• **James F. Olsen,** formerly sales manager of Turbo-Mixer Corp., a unit of General American Transportation Corp., has been transferred to the Chicago office of General American Process Equipment as manager of sales. **James A. Lane,** formerly stationed at Chicago, has been transferred to the New York office as assistant to the sales manager of General American Process Equipment.

• **Harry E. Keller,** general manager of the Associated Lines Tire and Accessory Sales Div. of the B. F. Goodrich Co., Akron, Ohio, for the last 20 yr , has retired from active business after nearly 43 yr with the organization and **Chester E. Carroll** has been named his successor. Mr. Carroll had, since 1935, been assistant general manager of the division.

• **Tech. Sgt. Kenneth R. Corson** has recently returned from the Pacific and plans to resume his connection with the Continental Screw Co., New Bedford, Mass. While Mr. Corson's territory prior to entering the service was Ohio and Indiana, he will now cover the Metropolitan New York area embracing northern New Jersey and New York City.

HARRY WILSON, JR., first vice-president, Jessop Steel Co.

• **Harry Wilson, Jr.,** formerly vice-president in charge of operations, has been elected first vice-president of the Jessop Steel Co., Washington, Pa. Mr. Wilson has been associated with the Jessop Steel Co. for the past 40 yr in various capacities, namely general superintendent, works manager and vice-president in charge of operations.

• **Frederick J. Bruckner** has been appointed assistant manager of sales for the Chicago district of the U. S. Steel Supply Co. Associated with the company since 1927, he has been manager of Stainless, Alloy and Aircraft Steels Div. since 1943.

• **Com. Allan Johnson** has returned to his former duties in the sale of pig iron and coke in the Philadelphia office of Debevoise-Anderson Co., Inc.

• **R. Resch** has been elected president of the Industrial Unit Heater Assn., Detroit. **F. P. Kohlbry** has been elected vice-president, and **L. O. Monroe,** secretary-treasurer.

• **A. F. Tenney** has been appointed Southern Ohio district sales manager for the Lithium Co., with his headquarters in Dayton, and will cover Louisville, Ky., and Evansville, Ind., in addition to his Southern Ohio territory.

• **Ted Nagle** has been appointed director of sales and advertising of Hydraulic Machinery Inc., Dearborn, Mich., and associated companies, Superdraulic Corp., Dearborn; Steel City Testing Laboratory, and Electro Mechanical Devices Co., Detroit.

• **Capt. Henry E. Craven** has returned to Pemco Corp., Baltimore, as plant superintendent. He first joined Pemco in 1932 as a ceramic engineer in the control dept.

• **Frederick H. Neuhardt,** formerly with General Electric Co., has joined Eastern Metal Products Co., Tuckahoe, N. Y., as sales manager of their Industrial Div.

• **Joseph J. Gilbert** has recently returned to Link-Belt Co. from his wartime service with the U. S. Army. He assumes the position of sales engineer, Sanitary Engineering Div., and will make his headquarters at the company's Philadelphia plant.

• **A. H. Freeman** has been appointed sales representative of American Foundry Equipment Co., Mishawaka, Ind. His headquarters will be in Milwaukee. **Vernon S. Spears,** who had served for several years in the Northern Indiana sales territory, has been named sales representative covering practically the entire state of Indiana. **Charles E. Ludwig** has been named sales representative in a newly created territory with headquarters in Buffalo; **Donald E. Matthews,** sales representative with headquarters in St. Louis, and **Joseph F. Underway,** sales representative with Houston, Tex., as his headquarters. **Robert A. Campbell** has been named Canadian sales engineer with headquarters in Toronto. **G. R. Bryant,** formerly a sales engineer for General Electric Co., has become associated with the company as sales engineer in the Detroit office. And **John N. Harper** has been appointed sales representative with headquarters in Pittsburgh.

• **Dr. Victor Wouk** has recently joined the Engineering Laboratories staff of North American Philips Co., Inc., at Dobbs Ferry, N. Y.

• **John A. Bauer,** with the Hanson-Van Winkle-Munning Co., Matawan, N. J., for almost 20 yr, has been appointed sales manager of the company. **Ralph R. Granquist** has been appointed manager of the Chicago office, and **Harold R. Smallman** remains in the Chicago office as western manager. **William J. Wise,** formerly a field representative of H-VW-M, has rejoined the company after having served in the U. S. Navy. He will make his headquarters in Dayton. **Edward M. Close** has been appointed assistant purchasing agent. **Walter J. Jurman,** who was with the company for a number of years before the war and has recently been discharged from the Navy, has been assigned to the Chicago office where he will be in charge of the order dept. **Hugh V. McGuire,** also discharged from the Navy, has rejoined the company and is assigned to the sales engineering dept. at Matawan. **Robert A. Noland** has joined H-VW-M as a field representative and is located at the Chicago office. And **Myron B. Diggin,** chief chemist of Hanson-Van Winkle-Munning, has been appointed director of Project No. 4 of the AES research committee.

• **H. C. Irvin,** manager of the Marketing Div. of Rheem Research Products, Inc., has been appointed manager of the Eastern Div., with headquarters in Baltimore.

• **Harold R. Eicher,** formerly assistant to the president of the Master Electric Co. of Dayton, has been appointed sales manager of the Industrial Equipment Div. of the company.

ALLYN DILLARD, secretary, Reynolds Metals Co.

• **Allyn Dillard** has been appointed secretary of the Reynolds Metals Co., with headquarters in Richmond, Va. Mr. Dillard joined Reynolds last November. For 17 yr prior to this he practiced law in New York City.

• **Donald H. Gilmore,** formerly with Bendix's Landing Gear Div., has joined the magnesium sales staff of the Dow Chemical Co. in their Cleveland office. **Francis T. Furman** has been transferred from the Midland to the New York sales office, to devote his attention chiefly to the sale of magnesium ingot and melting fluxes to foundries and die casting plants. **Robert L. Featherly,** recently released from the Navy, has returned to Dow as a member of the magnesium sales staff on cathodic protection.

• **L. A. Beeghly** has been reelected chairman of the board of directors of Cold Metal Products Co., Youngstown. **W. B. Lockwood,** formerly general manager of the company, has been elected president to succeed Venice J. Lamb, and **Charles M. Beeghly** has been named vice-president to succeed Howard S. Lamb. The new board of directors will consist of these three, plus **W. H. Kilcawley,** secretary and treasurer, **W. E. Bliss** and **James L. Beeghly.** Charles M. and James L. Beeghly replace Howard S. Lamb and A. P. Steckel on the board of directors.

• **Harvey A. Craig** has been appointed Pacific Coast manager, Republic Steel Corp. In this new post, created to bring under one head the many sales problems peculiar to the Coast, Mr. Craig will supervise the territory served by all three Coast sales offices. He will, however, retain his position as manager of the Los Angeles office.

• **I. C. Smith** has been appointed chief engineer of the Crocker-Wheeler Div. of Joshua Hendy Iron Works, Ampere, N. J.

• **Joseph A. Kendall** has been appointed assistant resident manager of the new Hamilton, Ohio plant of Fisher Body Div. of General Motors Corp.

• **Harry D. Franklin,** executive vice-president of Smith & Mills, recently purchased machine tool company, will be in complete charge of expanding facilities of the plant, now owned by Harris, Karp, Goldsmith & Co., commercial investors of Cincinnati.

...OBITUARY...

• **Edward D. Townsend,** sales representative of the Eureka Fire Brick Works, Pittsburgh, died Jan. 20.

• **L. C. Gillard,** 62, secretary of the James Mfg. Co., Ft. Atkinson, Wis., died there Jan. 29. He had been with the firm since 1907.

• **William L. Woodard,** retired specialist in stainless steel, died in S. Yarmouth, Mass., Feb. 1. During the war he did important steel work for propellers at the Curtiss-Wright plant in Caldwell, N. J.

• **Charles Lange,** 82, died at his residence in Cincinnati on Jan. 23. He was one of the founders of the Buckeye Foundry Co.

• **Albert K. Andrews,** 67, son of the founder and retired president of the Andrews Steel Co., Newport, Ky., died recently in a hospital in Palm Beach, Fla., after an illness of four months.

• **Dan C. Swander,** chairman of the board of the Columbian Vise & Mfg. Co., Cleveland, died Jan. 27. He was one of the founders of the company in 1926.

• **Louis C. Bihler,** former general traffic manager of Carnegie-Illinois Steel Corp., died Jan. 28. Mr. Bihler joined Carnegie Steel Co. in 1895 as assistant to the general freight agent and was appointed general traffic manager and assistant to the president in 1928, a position that he held until his retirement in 1932.

WORTH REMEMBERING

see Fairbanks-Morse FIRST FOR DIESELS

One of the first Diesel engine manufacturers in this country, Fairbanks-Morse has pioneered a notable list of Diesel improvements. As a result, Fairbanks-Morse Diesels have earned an enviable reputation for outstanding performance.

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Scales • Motors • Pumps • Generators
Magnetos • Stokers • Railroad Motor Cars and Standpipes • Farm Equipment

Dear Editor:

METAL FINISHING

Sir:

We are herewith enclosing 50¢ in currency for the reprinted articles on "Metals, Finishes, and Finishing Processes."

R. P. LAVIETES
Shelton Plane & Tool Mfg. Co., Shelton, Conn.

● Reprint has been forwarded.—Ed.

JOB EVALUATION

Sir:

In your Jan. 10 issue there was an article entitled "Common Sense in Job Evaluation" and it ended on p. 53 presumably to be continued on some other page. However, I was unable to find the end of this article in the particular issue. Can you advise me something about this?

I. I. ISLAMOFF
Bellanca Aircraft Corp., New Castle, Del.

● This article ended on p. 53, and there should be a period instead of a colon at the end. Also the word "following" in the last paragraph should be "above". In other words, the last paragraph should read: "The above tabulation indicates the values applied for each characteristic."—Ed.

HEAT RESISTANT STEEL

Sir:

We have read with interest the article commencing on p. 74 of the Nov. 8 issue entitled "Selecting the Proper Heat-Resistant Steel" by R. A. Lincoln, and we would be pleased to receive ten reprints of this article.

W. F. HEARNE
Toronto Iron Works, Ltd., Toronto

● Sorry, we did not reprint this article, but we are forwarding you several tear sheets. —Ed.

GERMAN STAINLESS STEELS

Sir:

I would appreciate receiving a copy of the article "German Stainless Steels" by Alexander L. Feild as published in the Dec. 20 issue.

M. DAVIS
Eastern Stainless Steel Corp., Baltimore

● Tear sheets have been mailed.—Ed.

MULTIPLE SPINDLE DRILLING

Sir:

We ask that you mail us three copies of the article "Time Allowances for Multiple Spindle Drilling" which appeared in the May 31, 1945 issue, and are enclosing herewith 45¢ in stamps to cover the cost.

R. KAMINSKI
Langelier Mfg. Co., Providence 7

● Reprints have been mailed.—Ed.

COMPARABLE TOOL STEELS

Sir:

Please advise where we can obtain a few copies of the "Chart of Comparable Tool Steels" prepared by Rolf G. Sartorius, which appeared in your publication of Aug. 28, 1941.

H. C. VUILLE
Steel Equipment Div. Bonnot Co., Canton, Ohio

● Our supply of the chart which appeared in the Aug. 28, 1941 issue is completely exhausted. However, we reprinted the revised edition which appeared in the Feb. 1, 1945 issue. The cost of this chart is 15¢ a copy. —Ed.

ELECTROFORMED IRON

Sir:

The article by J. Albin in THE IRON AGE of Jan. 10 entitled "Precision Seamless Tubing by Electrodeposition" has been read and discussed by our technical staff with a great deal of interest. We are particularly interested in the iron plating of copper. For a number of years we have had occasion to have some of our soldering iron tips iron plated. It would appear from Mr. Albin's article that there has now been discovered a process which could iron plate copper in any required thickness up to 1/16 in. without defects and blemishes. We would appreciate your putting us in touch with someone who is now doing work of this nature.

G. O. WHEELWRIGHT, Purchasing Dept.
Vulcan Electric Co., Danvers, Mass.

● Suggest you write to Mr. H. D. Rice, U. S. Rubber Co., 1230 Sixth Ave., New York 17. —Ed.

HOT-TOP VOLUMES

Sir:

In Mr. J. P. Gill's informative article in your Sept. 13 issue, the ratio of hot-top volume to ingot volume seems incorrect, or at least not according to accepted practice. Could I have more information on the exact dimensions and weights involved?

ENG. F. FABRIANI
Arsenal de Marinha, Ilha das Cobras, Rio, Brazil

● Mr. Gill states that the exact dimensions were given of a tapered round ingot and the hot-top. The size of the ingot was stated to have a weight of 400 kg. Using the dimensions of this ingot with a top diameter of 300 mm, a bottom diameter of 235 mm and a length of 800 mm, the volume would be 45,629 cc corresponding to a weight of 395 kg for 18 pct tungsten high-speed steel and 358 kg for a 1.00 pct carbon tool steel. The volume of the hot-top used for this ingot would be 9803 cc corresponding to a weight of 85 kg for 18 pct tungsten high-speed steel and 76 kg for a 1.00 pct carbon tool steel. The hot-top, therefore, represents a total volume closer to 20 pct of the whole than 10 pct as reported. The size of the hot-top and the ingot was quite proportional for all sizes.

The hot-tops were made of an iron ring cut from a piece of pipe into which was rammed the clay for the forming of the hot-top. It was this assembly which was baked and heated at a temperature of about 600°F and then placed, while hot, on the top of the mold at the time of casting.

It was reported that the usual practice was to use approximately 4 lb of aluminum for 10 tons of steel. This practice referred specifically to the melting of carbon and low-alloy steels, such as ball bearing steels. Four pounds for each 10 tons is approximately 0.02 pct. No aluminum was used in high-speed steels.—Ed.

BASING POINT SYSTEM

Sir:

I will appreciate if you will send tear sheets of the article "ABC of the Basing Point System" published in the Oct. 4 issue of your magazine.

F. J. SELTZER
National Credit Office, New York 16

● Tear sheets have been mailed.—Ed.

POWDER METALLURGY

Sir:

Please send me one copy of "Powder Metallurgy Precision Parts" by R. Hradecky and Richard P. Seelig, Sept. 27 issue.

M. McCANN
Towle & Son Co., Philadelphia

● Tear sheets have been sent.—Ed.

75S ALCLAD

Sir:

We would appreciate it if you would furnish us with one reprint of "Heat Treating, Forming, and Welding 75S Alclad" by Mitchell Raskin which appeared in the Dec. 6 and 13 issues.

H. EARLE MOORE, Chief Inspector
McDonnell Aircraft Corp., St. Louis

● Reprints have not been made of this article. However, we are mailing tear sheets. —Ed.

FUEL OIL

Sir:

We would be most interested in securing some information regarding the use of fuel oil for enrichment of gases used in steel plants for heating, as well as for metallurgical furnaces.

E. V. ENEVIK, First Vice President
Uddeholm Co. of America, Inc., New York 17

● We would suggest you write to the Assn. of Iron & Steel Engineers, 1010 Empire Building, Pittsburgh. Through their blast furnace and openhearth committees, they can give you complete data on this subject.—Ed.

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This Industrial Week . . .

- **Steel Price-Wage Issue Settled**
- **Average Rise to Be $5 a Ton**
- **Ingot Rate to Rise Slowly**

AFTER a loss of approximately 6,000,000 tons of steel and $60,000,000 in wages of basic steel employees, the steel wage-price issue has been settled and the strike is expected to be ended probably this week. The only bar to steel workers going back to work the latter part of this week or next Monday, Feb. 18, would be a disagreement over the retroactive feature of the wage increase.

Steel workers will get their 18.5¢ an hr—President Truman's compromise which represents a scaling down from the union's original demand of 25¢ an hr which was subsequently cut to 22.5¢, 20¢ and 19.5¢. The steel industry is to obtain an average increase of $5 a ton on carbon and alloy steels. Two weeks will be required to allocate $4.50 of the $5 advance among various steel products. Three weeks will be required to distribute the remaining 50¢ a ton among certain steel products.

This price advance is not an across-the-board adjustment, with the result that when final price details are worked out some products will be raised more than others. This method is for the purpose of attempting to restore or keep the basic relationship between the price of semifinished steel and finished steel in order to alleviate hardship for the small nonintegrated steel companies. The only reason the steel price announcement had not come out earlier this week was that it was held in abeyance until the broad pricing policy of the Administration was completed and announced.

President Truman had set a retroactive date of Jan. 1 for the wage advance, but the steel industry held out for the date on which the men returned to work. Furthermore the price advance is to take effect officially the day the men return to their jobs. Since it will take some time to work out the details of allocating the price advance to various products, steel customers will receive an additional billing to take care of the difference between the old price and the new.

On the basis of 55,000,000 tons of finished steel per year (approximately the output for 1945) the price advance of an average $5 a ton will bring the industry close to $275,000,000 a year, while a wage advance of 18.5¢ an hr will cost about $183,000,000. The difference will fall short of what the industry has claimed is necessary to make up for past accumulated costs. The OPA in 1945 consistently promised the industry that price relief would be granted for these accumulated costs.

It is to be expected that the steel wage-price settlement will not be satisfactory to all steel companies. However, the major agreement on prices between the government and the U. S. Steel Corp. and on wages between the steel corporation and the union will be accepted by the rest of the industry.

WITH final negotiations between the U. S. Steel Corp. and the United Steel Workers of America expected to take place this week, it is probable that steel production will, by Monday or a few days sooner, begin the long upward move towards prestrike operation levels. The length of time it will take for the industry to reach such an operating rate may run into weeks. Some companies will be able to step up their operations rapidly, while others may require from one to two months before the prestrike ingot rate is obtained.

Some of the larger integrated companies will take longer than others because of necessary repairs and rehabilitation to blast furnaces and coke ovens. Some of the smaller companies whose operations are not so integrated may take a much shorter time to resume output. However, during the first week of the resumption of steel output it is unlikely that the operating rate will climb much if any beyond 50 pct of capacity.

The steel operating rate this week dropped one point to 5.5 pct of rated capacity, the lowest point in history.

Steel orders continued during the past week at a sharply curtailed level, but next week mills will probably face one of the largest volume of inquiries since peak war periods. Because steel orders now being received are for production several months from now, the drop does not bear a direct relationship to the strike, but undoubtedly has been influenced by the uncertainty of future requirements.

FOLLOWING the official and public settlement of the steel price-wage controversy a flood of detailed problems will have to be cleared up. The plight of the steel processor and the steel fabricator will probably be taken care of by the Administration's basic price policy, but even then some may find themselves in a position where running into the red will not be unusual.

Furthermore a large number of steel producers accounting for a small proportion of total steel output may find the settlement made by the large steel companies difficult to digest. This is especially true on the basis of loss figures during the latter part of 1945. This outlook is believed to be one reason why the OPA consistently refused to agree to an "across-the-board" increase in steel prices which would have accentuated the disparity between the prices of semifinished steel and finished steel products.

Despite the steel strike the nation's scrap situation was tighter than ever this week. While many manufacturing concerns had shut down, thus cutting off the flow of scrap from those quarters, steel producers in some instances were having dealers lay aside scrap supplies for use when the strike was settled.

• **YOUNGSTOWN COAL CASE**—Interstate Commerce Commission has set Apr. 1 as the date on which railroads serving the Youngstown district will have to effect some rate reductions on millions of tons of coal moving into the Youngstown district each year. Originally set for Jan. 1, the effective date was delayed to Feb. 1, and then to Mar. 1, and finally the new effective date was set to give the commission more time to consider applications of the railroads and the coal consumers for reopening the case. The commission originally set the rate reductions at 7¢ to 12¢ a ton. Railroads serving the district have contended that the rate cuts are not justified and that they will also reduce the roads' revenues from other sources. However, Youngstown Sheet & Tube Co. and Western Coal Operators Assn. have claimed that the reductions should have been much larger on the basis of evidence put into the record in the commission's investigation.

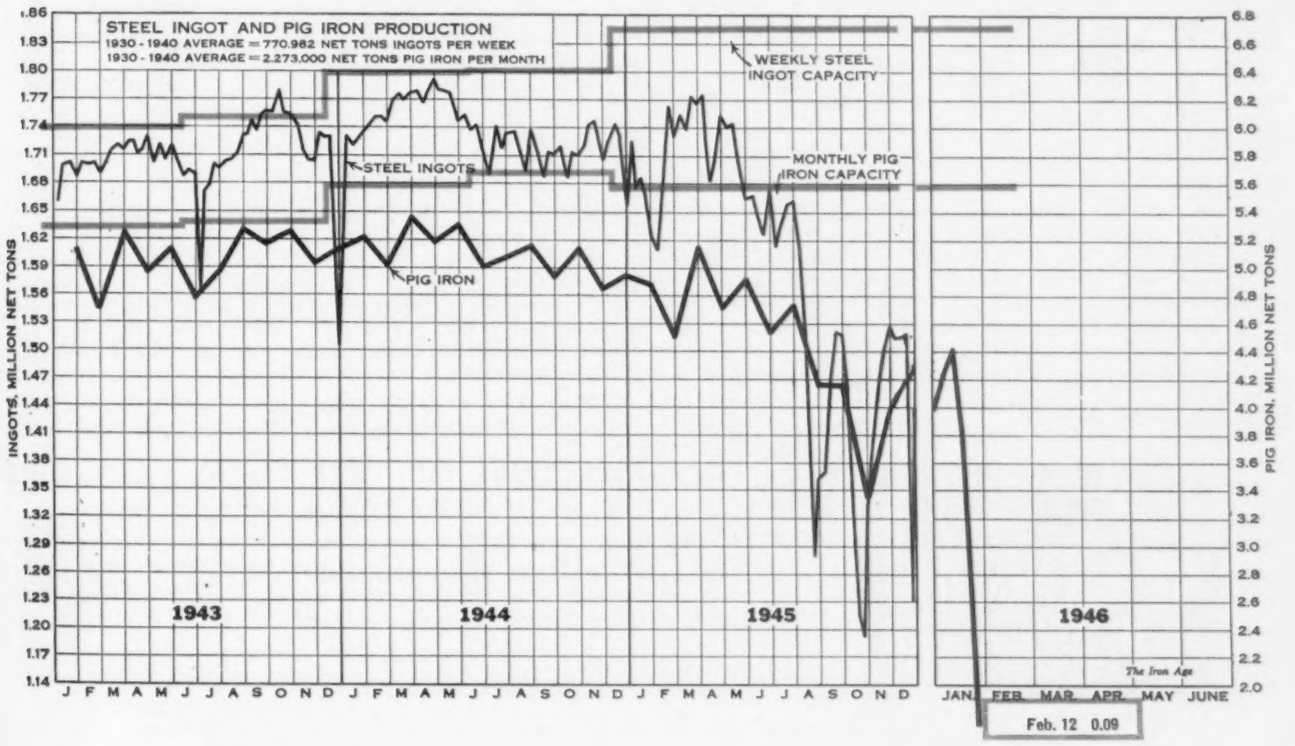
• **ORE MINERS STRIKE**—More than 18,000 iron ore miners, members of District 33, USW-CIO, joined the nationwide steel strike for higher wages Feb. 8 at 12.01 a.m. at the expiration of the 30-day "cooling-off" period prescribed by Minnesota's labor laws. With the walkout of approximately 10,000 miners in Minnesota's three northern ranges, operations in the Lake Superior District were brought to a standstill. Iron ore miners in Wisconsin and Michigan did not strike previously because district headquarters in Duluth were bound by the Minnesota law. About 8000 miners in the two states were affected.

• **BASING POINTS FOR PIPE**—National Tube Co., U. S. Steel Corp. subsidiary, has announced that effective Feb. 1 Chicago was established as a basing point applying to sales of carbon and alloy seamless mechanical tubing and carbon and alloy seamless heat exchanger and condenser tubes, within the range of sizes, grades and finishes produced at its Gary, Ind., plant. Pittsburgh will continue to be a basing point for similar products, prices at both points being the same and subject to OPA price ceilings.

• **PUBLIC STRIKE POLL**—In a public opinion poll, citizens of Kankakee, Ill., and nearby Bradley voted 6 to 1 in favor of the striking steel workers returning to work immediately and continuing wage negotiations with the companies. Mayor Al Nattenburg, who sponsored the poll, said the unofficial total was about 1800 for returning to work to 300 against.

• **BACK TO WORK**—The tool steel industry is gradually getting back to full production despite the steel strike and its slow solution. Some non-CIO shops, such as Carpenter and Vanadium Alloys, never went out on strike, but several CIO shops in the area of Pittsburgh, among which were Latrobe Electric Steel Co., Latrobe, Jessop Steel Co., Washington, Universal Cyclops Steel Co., Bridgeville, and Braeburn Alloy Steel Corp., Braeburn, Pa., made agreements with the CIO-USWA and are now operating.

• **CANADIAN LOCOMOTIVE BACKLOGS**—Locomotive builders in Canada have sufficient backlogs of orders on domestic and export account to keep plants operating at capacity into 1947. Officials of Montreal Locomotive Works state they are booked solid through 1946 and probably will continue at capacity for some time longer, in view of business now in sight. The company has just completed and delivered 30 locomotives to Canadian Pacific Railway and is about ready to start on another order of 20 locomotives for the C.P.R. It now is working on the balance of an order for 160 locomotives which was placed with the company last year by the Belgium Government. The company also has an order on hand for 100 locomotives for the French Government to cost approximately $13,000,000. Further orders for locomotives are pending.



Steel Ingot Production by Districts and Per Cent of Capacity

Week of	Pittsburgh	Chicago	Youngstown	Philadelphia	Cleveland	Buffalo	Wheeling	South	Detroit	West	Ohio River	St. Louis	East	Aggregate
February 5....	3.0	8.0	0	2.0	0	0	52.0	0	24.5	14.0	37.0	14.0	0	6.5
February 12....	3.5	4.5	0	2.0	0	0	52.0	0	25.0	14.0	37.0	14.0	0	5.5

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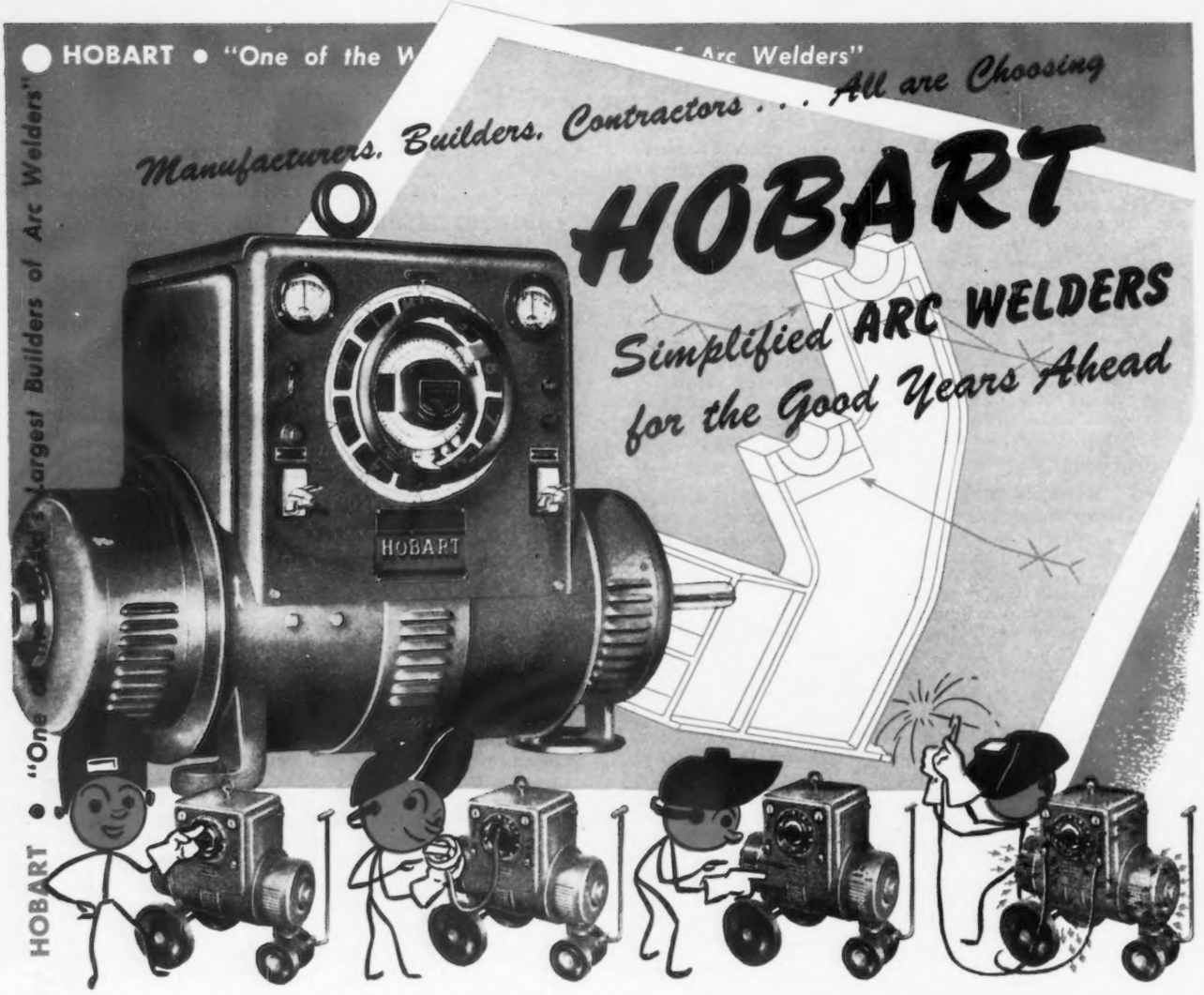

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Steel Price-Wage Issue Settled; Awaits Broad Policy

By TOM CAMPBELL

o o o

New York

• • • **The nation's steel** strike is practically settled; the steel industry will obtain an average of $5 a ton on its total carbon and alloy steel production, and the United Steel Workers of America are to obtain their demand of 18.5¢ an hr. The only thing early this week holding up an official ending of the strike was the working out of last minute details on the Administration's broad wage-price policy.

It is expected that by next Monday, Feb. 18, the steel workers will be back at their jobs and the slow process of building up to pre-strike levels will be started. The amount of time necessary for this job will range from a few weeks to two months depending on the steel company involved.

After weeks of intensive and secret negotiations between steel officials and high governmental authorities during which time it is believed the intricate system of steel pricing was reviewed from top to bottom, a compromise which would end the strike was agreed upon. It was not what the industry wanted and it was not what the government had expected to give. Labor, on the other hand, by keeping out of the price picture obtained the president's compromise offer of 18½¢.

One feature of the price advance allowed to the steel industry is the fact that it will be an average increase of $5 a ton on carbon and alloy steel and not an accross-the-board increase. It is believed that the industry will have two weeks to allocate price increases among the various products so as to arrive finally at an average of $4.50 a ton. Three weeks will be allowed to allocate the remaining average 50¢ a ton among other products.

TOUGH WORK: *With the steel wage-price issue settled, Chester Bowles probably figures the last few weeks will rank among some of his toughest periods. Furthermore it is believed that he now knows as much about the steel price structure as do many steel officials.*

Inasmuch as this is an industry job, it is expected that the steel industry advisory committee under the supervision of the OPA will make the proper allocations. The basic reason for this type of a price advance was to take care as far as possible of the plight of the non-integrated steelmaker. The process of allocating varying amounts of an increase to different products is for the purpose of attempting to restore or keep the proper relationship between the price of non-integrated steel and finished steel products.

It is to be expected that the wage-price solution for the steel industry will not be satisfactory to all steel companies, but it is expected that the major agreement between the government and the U. S. Steel Corp. on prices, and the union and U. S. Steel Corp. on wages will be accepted by the rest of the industry. It would be ridiculous to believe that leading steel officials have not been promptly informed of what has been going on.

Although President Truman had asked that the wage increase be made retroactive to Jan. 1, it is thought that the industry has held out for the date on which the men will go back to work. Furthermore, the price increase is to become effective on the day the men go back to work. Since it will take a few weeks to work out the details of allocating the price advance, customers receiving steel before that time but after the strike ends will subsequently receive an additional billing to take care of the difference between the old price and the new one.

On th basis of 55,000,000 tons of finished steel a year, the price increase to be allowed the industry will amount to approximately $275,000,000, while an 18.5¢ an hr raise for the basic steel industry would run to about $183,000,000 a yr. This would leave the industry much less than it has claimed would be necessary to make up for past increased cost and to take care of the current advance in wages.

Historically the advance of $5 a ton average does not take steel prices as high as they were in 1937, in the fall of which year price cutting broke out. By 1938 steel prices had slumped as much as $3 and $7 a ton. They never did fully recover at the time prices were frozen by OPA. With wage costs as high as they are, it is apparent that considerable improvement in the output of steel per manhour must be obtained if the industry is to live under the new arrangement.

It is expected that steel fabricators and steel processors are to be taken care of through the Administration's broad pricing policy for all industry which was to have been announced this week.

Type of Steel Products To Dictate Necessary Time for Resumption

Pittsburgh

• • • **The speed with which** steel companies will get back to prestrike operations depends upon the complexity of the individual company's operations plus the degree to which maintenance operations were carried on in the plants during the strike. A completely integrated company will naturally take longer to get back into full production than one that makes a narrow range of products.

Jones & Laughlin Steel Corp., which was closed down in Pittsburgh two days before the official strike date, estimates that it will take from two to three months to get back to normal. At the Pittsburgh works of J&L, there was considerable trouble with maintenance operations until last week, and a handful of supervisory employees plus those choosing to stay in the plants handled the maintenance for almost three weeks. At plants in Aliquippa and Cleveland operations should be attained sooner.

Carnegie-Illinois Steel Corp., expects that it will be a month before operations get back to normal. Shipment of some stocked items, such as tinplate, can be resumed almost immediately, but ironmaking, steel melting, semi-finishing, and finishing operations will take some three to four weeks. There was considerable work in process at the time of the strike, and much of this will have to be examined to see whether or not it can continue on through. Some sources expect that a considerable portion of this material will have to be scrapped.

National Tube Co., which makes pipe only, expects that operations will be back at near prestrike levels within a week, but this is dependent upon a full supply of coke and gas from Carnegie-Illinois Clairton works.

Most mills found that orders dropped sharply when the strike got underway. In fact, one mill refused to book any new orders since the strike started. In practically all cases, rolling schedules were re-examined carefully with an eye to simplification. However, without contact with mill scheduling departments, home offices of companies were handicapped in handling any rescheduling. With the exception of minor changes, mills plan to go ahead with schedules that were in effect at the time of work suspensions, with no preferencing of orders at the mill for about a month.

One large steel producer in this area expects that by the end of the first week back at work, operations will be in the neighborhood of about 20 pct. and it will be a question of steadily increasing those operations until desired peaks are reached.

A NEW WRINKLE: *Six of the regular pickets at the struck plant of The Davis & Furber Machine Co. plant at North Andover, Mass., appeared recently on horseback to carry out their daily stint for the United Steel Workers of America.*

Maintenance and Raw Material Supplies To Hinder Steel Pickup

New York

• • • **Technical considerations** alone will prevent the steel industry from reaching prestrike operating levels from four to six weeks following strike settlement. Repair and rebuilding operations which had been postponed prior to the strike, undoubtedly will hold production down additionally. The return to work of striking employees will be gradual during the four to six weeks' period as various facilities resume operation.

Although coke ovens at most plants have been held at low heat during the strike to prevent damage to the refractories, they must be returned to full heat before coke production can be resumed. This will require a varying length of time, but full production of coke is unlikely at larger plants before one week to 10 days following strike settlement.

Coke stocks on hand are limited, and blast furnace operation will be affected by the speed at which coke is available. Blast furnaces which have been banked will require about 12 days to reach capacity operation, and with one furnace being blown in at a time, additional time will be required to reach full operating levels at any given plant. Although some pig iron is produced within 30 hr after starting to blow in, some 60 to 72 hr are required to produce metal of steelmaking quality.

Because of the limited amount of cold pig iron and scrap available, resumption of openhearth steelmaking operations will be dependent upon the speed with which blast furnaces produce hot steelmaking iron. Operating men are crossing their fingers as to the condition of openhearth furnaces. Contractions resulting from cooling

may cause leaks in accessory pipes, collapse of masonry, or warpage of equipment not immediately evident. If equipment is in good repair, about two or three days is required to resume operations with the probability that steel can be tapped within 72 hr. However, lack of hot metal, cold pig or scrap, will probably keep operations below 50 pct of capacity until pig iron operations are resumed in full.

Efforts of steel producers prior to the strike to retain maximum operations to meet overwhelming steel demand resulted in much equipment being kept in operation which normally would have been shut down for repair. Now that a shutdown has been achieved, it is likely that many postponed repair operations will be undertaken with an unascertainable loss to immediate production.

Strenuous efforts were made to deliver all possible finished steel prior to the strike. With the result that steel in process in finishing depts. will be considerably below normal when finishing operations are resumed. The necessity for waiting for pig iron, raw steel and semi-finished steel to flow down the "pipeline" will make full resumption of finishing operations impossible until output is stepped up in the earlier stages of production. Because of heavy pressure for deliveries from all sides, most mills will attempt to resume schedules where they left off with the result that each customer will retain his place in line. Steel users who were far back on production schedules may have to wait two months before they receive all types of finished steel necessary to their operation. Economic steel mill operations require that finishing operations be concentrated on as few specifications as possible, keeping roll changes to a minimum.

In sections where steelmaking operations are adjacent to other industry, it is anticipated that manpower problems will be encountered due to workers drifting off to other occupations during the strike.

EVERYBODY HAPPY: *William Green, AFL president, second from right, appears happy with (left to right) David Dubinsky, New York; William C. Dorherty, Washington and Mathew Woll, New York, members of the AFL executive council. With John L. Lewis back in the fold these happy smiles may change from time to time.*

Steel Shortage Causes Shift in Tinplate Uses

Washington

• • • **Shortages resulting** from the steel strike has forced the CPA to set up a plan to channel tinplate into the production of containers for perishable and seasonal goods. Declaring that this action was necessary in order to protect the nation's food supply, CPA pointed out that it will have to be continued for a considerable period after the strike even if it causes a reduction in the output of such products as blackplate and terneplate. Also outlined was a program to funnel virtually all currently avaiable tinplate to manufacturers of cans and closures.

At meetings of the Canners' Industry Advisory Committee and the reinstated Tinplate Industry Advisory Committee, it was agreed that tinplate production could not be resumed on a pre-strike basis until at least five weeks after operations were resumed.

The OPA regulations were effected through the issuance of Directions 9 to orders M-21 and M-81. Direction 9 to M-21 requires producers of tin mill products to schedule maximum production suitable for making cans or closures for packing of food products. This direction, therefore, will concentrate tin mill production on tinplate, while subordinating output of terneplate and blackplate.

Tin mill producers unable to fill all orders for tin mill products in the month for which deivery is requested are required under Direction 9 to M-21 to schedule orders in the following sequence:

(1) a—Orders certifying that tin mill products will only be used for making cans for perishable or seasonal food products and for other products as outlined above.
b—Orders certifying virtually the same as above, for Canadian production, bearing the symbol PCC.

(2) Orders for terneplate or tin mill blackplate for production of cans listed in schedule A of order M-81 or to make closures.

(3) Any other orders for terneplate or tin mill blackplate.

Direction 9 to order M-21 also specifies that all deliveries of tinplate and hot dipped tin plate waste (imperfect tinplate) must be confined to orders with the certification as outlined above.

In Direction 9 to M-81, virtually parallel provisions are listed as those in Direction 9 to M-21 except that M-81 provides that until Feb. 17, can manufacturers may continue to use the tinplate not suitable for the products mentioned above for other food products.

Membership of the newly organized Tinplate Industry Advisory Committee includes: J. A. Henry, Weirton Steel Co.; Leslie Irvine, Wheeling Steel Corp.; Arthur M. Long, Youngstown Sheet & Tube Co.; William Stephens, Bethlehem Steel Corp.; Nathaniel B. Randolph, Granite City Steel Co.; G. E. Totten, Carnegie-Illinois Steel Corp.; A. C. Roeth, Inland Steel Co.; D. W. Thomas, Jones & Laughlin Steel Corp.; J. G. Corruthers, Republic Steel Corp.; and Thomas Chalmers, Tennessee Coal, Iron and Railroad Co.

Steelmaking Capacity Drops as Inefficient Units Are Abandoned

New York

• • • **Steelmaking capacity** in the United States as of Jan. 1, 1946, is rated at 91,890,560 tons of ingots and steel for castings per yr, a decline from the wartime peak but by a large margin the highest capacity ever available in this country in a peacetime year, according to a report released today by American Iron & Steel Institute.

In January 1945, capacity was rated at 95,505,280 tons per yr. The decline since then reflects chiefly the abandonment of some of the older steel-making facilities in the industry. During the war years, almost 14 million tons of new capacity were installed to meet emergency demands.

The current steel capacity is more than 20 million tons, or nearly 30 pct, greater than the capacity available in 1929, and is 10 million tons greater than was available at the outbreak of World War II.

At the present time, open hearth steelmaking capacity is rated at 81,236,250 tons per yr, down about 2.9 million tons from the rated capacity a year ago.

Electric furnace steel capacity is currently rated at 5,500,290 tons per yr, up about 45,000 tons from a year ago.

Bessemer steelmaking capacity, once the greatest of all from the tonnage standpoint, now stands in third place. At the present time, bessemer steel capacity is rated at 5,154,000 tons per yr, against 5,874,000 tons per yr on Jan. 1, 1945. The capacity for making steel by the crucible process is now rated at 20 tons per year, as against 3800 tons a year ago.

Blast furnace capacity increased slightly during the year and is now rated at 67,340,590 tons of pig iron and ferroalloys per yr. On Jan. 1, 1945, blast furnace capacity was rated at 67,313,890 tons annually.

Canada Lifts Ceiling Prices on Some Items

Toronto

• • • **The Canadian** Government is showing some indications of abandoning or easing ceiling prices on various commodities. On certain luxury items ceiling prices have been discontinued. Announcement was made recently to the effect that Canadian nail producers have been granted permission to increase the price on all types of nails 35c per 100 lb. This increase applies to producers, wholesalers and retailers, but in the case of retailers distributing nails in less than keg lots the price is advanced 50c a keg as their selling price.

While there has been no actual increase in steel prices, sanctioned by the government, producers have discontinued all discounts, thus in the future all invoices on steel will be 30 days net instead of the usual discounts for cash in 10 days. This ruling applies to bars, sheets, plate and most other items, with the exception of woven wire fences.

Lukens Steel Reports Sharp Drop in Income

Coatesville, Pa.

• • • **Of each dollar** received by the Lukens Steel Co., Coatesville, for the fiscal year ended Oct. 6, 1945, 58.4¢ went for the purchase of materials and supplies, according to the company's annual report to stockholders. To employees went 34.9¢ and 5.1¢ went for other costs, including selling, administrative and interest charges. Taxes and insurance took 1.5¢, leaving only 0.1¢ out of every dollar for dividends and surplus.

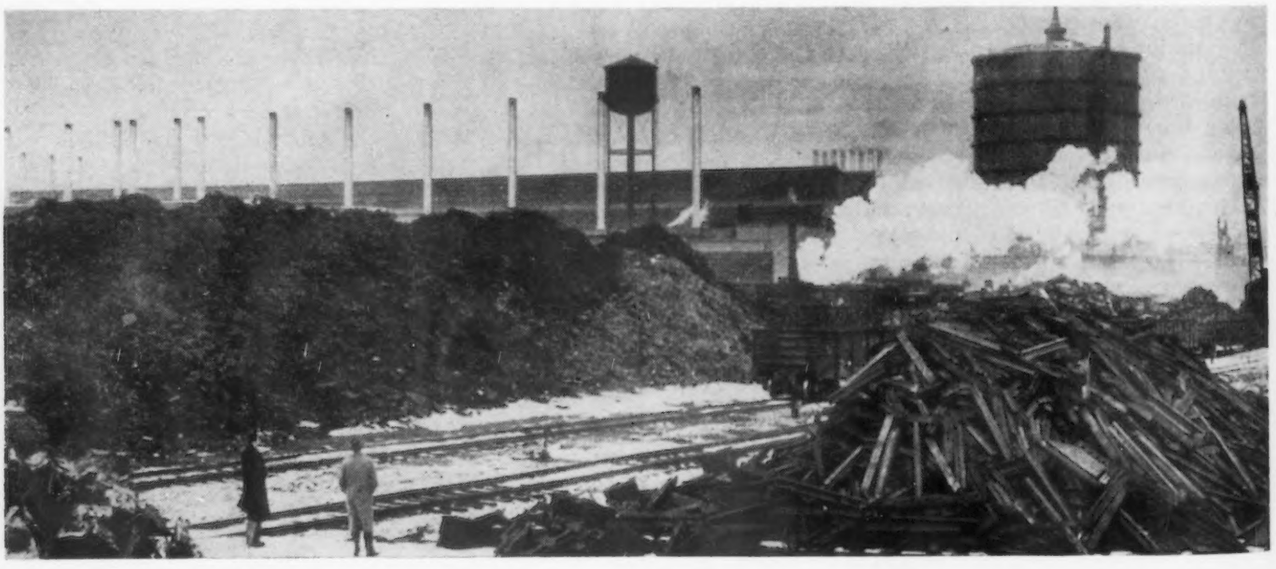
Consolidated net sales for the company and its subsidiaries, By-Products Steel Corp. and Lukenweld, Inc., for the fiscal year totaled $45,243,988.18 or 17.1 pct less than the adjusted figure of $54,576,770.36 for the previous period.

Operating income for the current fiscal year amounted to $41,477.56 as compared with $955,789.68 for the 1944 fiscal year.

The number of employees of the company for this period dropped to 5175 from 6166 the year before. Payroll, wages and salaries accounted for $15,801,234.81 in 1945, a decline from the 1944 adjusted figure of $18,600,208.06.

For the 12-week period ended

SCRAP SUPPLY DOWN: *Shown here is a supply of less than two weeks' scrap for the Ford Motor steel mills, pictured in the background. Officials are fearful that lack of scrap will force the company's steel works down soon.*



Dec. 29, 1945, net loss of the company before income tax recovery was $448,278.91. Since the company estimates a refund of federal taxes on income of $291,350, the loss transferred to earned surplus amounted to $156,928.91. Net sales for this period was $6,626,246.63.

National Steel Final Quarter Shows Loss

Pittsburgh

• • • **National Steel Corp.**, in a preliminary statement subject to final audit, reports net earnings for the year 1945, after all charges, of $11,117,764, equal to $5.04 per share on 2,206,492 shares of capital stock. This compares with earnings for the preceding year of $10,751,369, which equaled $4.87 per share on 2,206,392 shares.

Net earnings for the fourth quarter of 1945 were $2,207,091, equal to $1.00 per share, compared with earnings of $2,670,396, equal to $1.21 per share in the final quarter of 1944.

Net profit for the fourth quarter and the year ended December 31, 1945, is after charging off the unamortized portion of the cost of emergency facilities applicable to the period from Jan. 1 to Sept. 30, 1945, on the basis of the shorter term of amortization provided by law. The amount of amortization charged off was $5,496,948, which resulted in a reduction in federal taxes on income of $4,620,000, leaving a net charge of $876,948 against income.

Wheeling Sales Increase

Wheeling, W. Va.

• • • **With sales in** excess of $137,000,000 for the year 1945, an all-time record was established for Wheeling Steel Corp. and subsidiary companies. A preliminary report of earnings for the year, as reported to its board of directors, shows a net profit for 1945 of $3,950,252 after all charges including federal taxes and compares with net earnings for 1944 of $4,384,789. Reported earnings for 1945, after providing for full dividends on preferred stock outstanding, are equivalent to $3.75 per share on the 569,559 shares of common stock outstanding on Dec. 31, 1945, as compared with $4.51 per share for 1944.

Midvale to Build Stainless And Tool Steel Cold Drawn Bar Mill

Philadelphia

• • • **The Midvale Co.**, one of the few steel producers not closed down in the current strike, expects to have in production in the next four or five months a new bar mill designed for the production of cold-finished stainless and tool steel bars in all commonly used sizes and shapes.

The new mill, a project originated in order to permit Midvale to offer cold-finished alloy bars in a wider range of sections and sizes, will incorporate some equipment considered to be unique among stainless mills. Midvale contemplates the production of many special tool steels on the bar mill, among them a number will be new departures for the company. It also expects to be able to produce drawn valve steels at a low cost.

The new bar mill, Midvale engineered and installed, designed under the supervision of Benjamin M. Fine, specialty engineer, and H. M. Givens, superintendent of rolling mills, will permit the production of rounds from ¼ in. to 4 in., squares ¼ in. to 2½ in., flats up to cross sections equivalent to 2½ in. square, and hexagons up to 2 in.

The cold-finished alloy bar mill facilities, housed in two new buildings, will include five centerless grinders, a multiple bar drawbench, pickling, passivating and coating equipment, repeaters and coiling equipment, annealing and heat treating facilities, additional straightening and cut off equipmet, small cropping shear, bar pointing machine and necessary auxiliary equipment. There will also be improvements to hot mill facilities to permit the production of bar in coils for subsequent cut off.

The company has recently placed in service a new 2 million volt X ray machine specially designed for Midvale by General Electric Co. to inspect its production of alloy gas turbine rotors. This equipment will be employed for inspection of the company's high alloy forging and casting production.

The Midvale Co. is well known for its production of alloy forgings and its facilities permit producing and handling massive gun forgings, armor plate sections and other ordnance equipment. The Navy equipped the plant with one of the largest forging presses in the world—14,000 tons—the only equivalent press being located at the Naval armament plant at Charleston, W. Va.

The company's civilian production is largely confined to forgings and rolled products involving intricate and highly specialized production facilities and techniques. Midvale produces a good proportion of the forged alloy steel rolls used by the steel industry. At this time its principal mass production item is the rolled carbon steel locomotive tire. All steel worked by Midvale is cast in its own plant. Melting facilities include 8 openhearths, 3 electric arc furnaces and 3 electric induction furnaces.

Names New Distributors

Cleveland

• • • **Appointment of a number** of manufacturers' supply firms as distributors of Parker Appliance Co. industrial fittings and tube bending equipment has been announced by D. A. Cameron, sales manager.

The new distributors are: Whitehead Metal Products Co., New York, Boston, Buffalo, Newark and Philadelphia; Williams & Co., Pittsburgh, Cleveland, and Cincinnati; A. E. Borden Co., Boston; Carey Machine & Supply Co., Baltimore; Louis H. Hein Co., Ardmore, Pa.; Squier-Schilling & Skiff, Newark; Somers-Fitler & Todd, Pittsburgh; W. M. Pattison Supply Co. and Strong-Carlisle & Hammond, Cleveland; Great Lakes Supply, Chicago; Vincent Brass & Copper Co., Minneapolis; Metal Goods Corp., St. Louis, Tulsa, Dallas and Houston; General Machinery & Supply and American Brass & Copper Co., San Francisco; Metropolitan Supply Co., Los Angeles; and Eagle Metals Co., Seattle.

Small Producers Fear Discrimination in Deliveries

LONG CHANCE: *In calling one of the biggest strikes in the nation's history, Philip Murray is believed to have taken a long chance which involved the very future of his union. Now that the issues are settled, his steel workers will receive 18.5¢ an hr as contrasted to the original demand of 25¢ an hr.*

• • By GENE HARDY • •

Washington

• • • **Accusing the larger** producers in the steel industry of pressuring for a straight across-the-board increase on all carbon products, regardless of the amount of the eventual increase, Warren Huff, Price Executive of OPA's Metals Price Branch, told the Senate Small Business Committee on Feb 7., that unless overruled OPA would apply the increase in varying amounts to assure the production of badly-needed and in many cases unprofitable products, particularly those in the flat-rolled category

Mr. Huff said the application of the increase would be based on the following principles, provided OPA was given a free hand in this regard:

(1) The relative profitability of the products

(2) The relationship of price to production in regard to extras, based on recommendations of the various industry advisory committees. This would take into account small orders, varying specifications, and other factors which reportedly work to the disadvantage of small users.

(3) Adjustment of prices so as to prevent squeezing of the non-integrated producers.

The hearings (Feb. 7 and 8) at which Mr. Huff testified were held as a result of complaints from small users who allegedly cannot get adequate deliveries and who were fearful that when the steel strike is ended they would not be able to obtain fair treatment from the mills.

Much of the committee's line of thought was directed to re-institution of large-scale issuance of ratings for steel products, based on the essentiality of end-products, so as to assure equitable distribution to small users.

Appearing for CPA, Patrick Treacy, director of CPA's Steel Branch, was not particularly receptive to the Committee's suggestions. Mr. Treacy said it would be CPA's policy to refrain from issuing ratings for steel products for what he termed a shakedown period of four to five weeks after the termination of the strike. It was Mr. Treacy's view that to issue ratings during this period would upset production schedules and that it would be extremely unwise to issue any ratings until normal operations were resumed. Ratings issued before the strike would not be reinstituted until the end od this shakedown period.

Mr. Treacy also told the committee that CPA had recommended subsidies for five non-integrated producers of sheet bars. However, since this recommendation one of the five producers has ceased operations.

Taking cognizance of the close relationship between price and production of steel products as well as others, the Committee suggested merging the activities of OPA and CPA for the remainder of the emergency period. It will recommend this course of action in a formal report to be issued shortly.

Appearing for the small steel users were approximately 10 Midwestern manufacturers representing more than 50 steel consumers, who reported what seems to be an almost universal difficulty in obtaining flat-rolled products. The emphasis was placed on the supply position of galvanized sheets, used in the production of farm products, which is further complicated by an unprofitable price situation.

Typical of the testimony offered was that of Max L. Rysdon, president, Sioux Steel Co., Sioux Falls, S. D., producers of galvanized agricultural equipment and structural sheet metal. Mr. Rysdon said that he had placed orders for almost 3000 tons of galvanized sheet with four mills for first quarter production and had received acknowledgments of the orders. Two mills later informed Mr. Rysdon that they would be unable to deliver, and could not promise delivery anytime during 1946. The two remaining mills will deliver approximately 600 tons during the first quarter. Mr. Rysdon said this slash in deliveries will mean a curtailment of operations resulting in the laying off of 92 workers, mostly returned veterans.

Mr. Rysdon then told the committee that after investigation he discovered the followig to be the reasons for curtailment in his deliveries:

(1) The increases in cost of zinc and labor had reached a point where it was no longer profitable for the mills to produce their maximum output of galvanized sheet.

(2) The logical action on the part of the mills to supply their own fabricating subsidiaries first.

(3) The opening of a fabricat-

ing plant by one of the mills in Sioux Falls.

All the witnesses testified that they would be forced to shut down in 20 to 60 days unless steel was forthcoming. Some of their operations have already been cut to 20 pct of capacity.

In general, as a solution to their problems, the witnesses recommended:

(1) An OPA price policy which does not work against maximum production and does not restrict distribution.

(2) Issuance of ratings by CPA to guarantee distribution of steel to essential industries and small independent producers.

(3) Immediate reinstitution of suspended ratings when the strike is ended.

(4) Setting aside of a portion of all flat-rolled products for small users.

(5) Continuance of CPA beyond June 30, 1946, its present expiration date.

Mr. Huff told the committee that OPA was aware of the tremendous effect of price on the type of steel produced since CMP was discontinued, but maintained that if OPA is permitted to apply the steel price increase in the manner he had outlined, supplies of certain products would undoubtedly increase. While the committee seemed to agree with Mr. Huff, a rating system was still urged.

Speaking specifically about galvanized sheets, Civilian Production Administrator John D. Small, appearing at the second day's hearings, told the committee that the situation is one where regardless of what is done by the government, demand would still be greater than available supplies.

Mr. Small admitted that it was CPA's responsibility to insure equitable distribution of steel stocks, and contended that both producers and warehousemen were doing just that. To back up his contention he presented figures showing that CPA had received only 5548 applications for CC ratings up to Jan. 25, 1946. Firms employing less than 500 people accounted for 4845 of this number.

Read into the record by Dewey Anderson, committee staff member, was a telephone conversation with Charles R. Hook, president of American Rolling Mill Co., who told the committee that at the end of the strike his company will allocate production on the basis of customer purchases in 1941.

This solution did not meet with the approval of the small steel users, many of whom are customers of American Rolling Mill, because in their opinion 1941 was not a representative year and such an allocation would therefore work to the disadvantage of small manufacturers.

In response to a question from Mr. Anderson, Mr. Small said that he was against reinstitution of an overall priorities system, as it would tie up the whole national economy with a cumbersome rating procedure. Mr. Small was supported in this regard by the testifying small users, who pointed out that they did not favor the establishment of a complicated system, requiring large additions to the staff of CPA. Rather, they felt that since they have all had excellent treatment from CPA in the granting of CC ratings that a broadening of this system for the period immediately following the strike and granting of price relief to steel producers would solve their problems.

Mr. Small, in response to another question, said that while CPA had the power to force a producer to re-open galvanizing pots or any other facilities this would not be done if the product was being turned out at any loss.

Edward A. Livingston, general sales manager, Babcock & Wilcox Tube Co., and chairman of OPA's Steel Tubing Industry advisory committee, highlighted the problems which are confronting the non-integrated producers who are faced with higher material and wage costs.

Mr. Livingston said that makers of seamless and welded tubing showed losses as early as the first quarter of 1945, and that in the third quarter of 1945 this loss was greater than $10 a ton.

Accusing OPA of delay in granting requests for price relief, Mr. Livingston told the committee that an across-the-board increase on all products would further squeeze the non-integrated producers and would result in the closing of many facilities. Favoring a percentage-wise increase Mr. Livingston seemed to indicate that the type of producer he was representing would favor some such plan as had been advanced earlier by Mr. Huff.

When asked by Mr. Anderson for recommendations looking toward equitable distribution of supplies to small users, Mr. Livingston said that his company had already (1) cut off all export sales, (2) stopped taking new accounts for materials which are in tight supply, and (3) established more careful screening of orders in field offices.

Pittsburgh Producers Require Price Relief To Resume Operations

Washington

• • • **Wedged between higher** steel prices on one side and increased wages on the other, a group of steel fabricators from the Pittsburgh district came to town on Feb. 6 and demanded price relief lest a great many of the 834 plants that were closed by strikes will be unable to open. Consisting of a delegation from the Tristate Industrial Assn., representing 56 companies in the Pittsburgh district employing 51,237 workers, the comparatively small fabricators gave this warning to Reconversion Director John W. Snyder after having explained their plight to Pennsylvania Senators and Representatives from their own district.

Complaints made by the fabricators followed the lines made at recent meetings in Pittsburgh but were made official by the Washington trip.

Col. James S. Ervin, president of the association and head of the Mackintosh-Hempill Co., told government representatives that a recent poll of the association's member companies that were closed by the strike revealed that without immediate price relief almost none of them will be able to reopen and operate without loss if they must pay higher prices for steel and increased wages. He said that the prices of their products have been frozen at 1941 and 1942 levels and that many of the companies have been seeking price relief for a long time because they were operating either their entire plant or

some departments at a loss. Colonel Ervin declared if fabricators are compelled to pay higher wages and material costs with their own prices frozen, many of their 350,000 employees cannot be returned to work.

John P. Roche, assistant to the president of the Oliver Iron & Steel Corp., pointed out that while there was only temporary unemployment due to the steel strike, the unemployment that may follow can be of a much more permanent nature. President A. V. Murray of the Scaife Co., manufacturer of metal tanks, said that if these miscellaneous companies do not reopen their plants it will not do the steel manufacturers much good to try to keep operating because they won't have any buyers.

H. W. Rinearson, president of the Shaw-Perkins Mfg. Co., manufacturer of convector radiators, pointed out that none of that company's seven competitors in the country are on strike.

"They either have no contracts, or contracts with other unions than the CIO Steelworkers," Mr. Rinearson said. "The business we are losing now, and will continue to lose to our seven competitors if they keep working while we cannot reopen because of this situation, never will be recovered. The very existence of our company is seriously endangered and therefore so are the jobs of out 220 employees."

Power Strike Paralyzes Most Of Pittsburgh Industrial Activities

Pittsburgh

• • • **Slow paralysis** gripped the western Pennsylvania area Tuesday when a strike of the independent union of the Duquesne Light Co., shut off the power in Allegheny and parts of Beaver Counties. Eleventh hour attempts to ward off this strike by the Mayor of Pittsburgh, Governor Martin of Pennsylvania, and several federal officials brought no compromise in the union's demand for a 35 pct pay increase which was countered by a company offer of 7.5 pct. George L. Mueller, union president, called Duquesne Light employees off the job at 4.00 A.M. Tuesday, and by noon there was no power to speak of in the city. Schools, business establishments, and public buildings didn't open. Food supplies, especially milk and bread, were curtailed as soon as the power failed, and refrigeration units immediately stopped operation. Water supplies to high areas, dependent upon electrically driven booster pumps, quickly dwindled. Street railway service was stopped before the 4.00 A.M. deadline. The liberty tunnels, main traffic artery, were closed because their exhaust fans were idle. Airport and river navigation lights were replaced with oil flares and oil lamps.

A threat of Governor Martin to call out the Militia and the three requests of Mayor Lawrence to the federal government to seize the company were of no avail in stopping the strike. Challenged in seriousness only by the curtailment of public services during the famous St. Patrick's Day flood in March, 1936, the strike of power plant employees brought all business in the area to a complete standstill. Those companies that missed being struck by the CIO-United Steel Workers of America in the steel wage fight were closed down tight Tuesday because of power failure. The City of Pittsburgh was declared "in a state of emergency" by the Mayor, with Council meeting Tuesday to pass the resolution. Police and firemen were ordered on continuous service, with about 1000 auxiliary police being sworn in.

In commenting on the Mayor's request for seizure by the federal government, George L. Mueller, president of the company union, said that whether or not the union would work under government seizure depended upon "circumstances" and on "assurances" of wage increases. He expressed doubt that the government would seize the power plants until the strike was actually underway.

The union has demanded an immediate 20 pct "cost of living" increase and signified willingness to negotiate for an additional 15 pct for cutbacks in overtime. The company offered a 7.5 pct increase. Federal conciliator, Charles Kutz, asked Mueller late Monday evening if the union would accept a counter-offer. The answer was: "No, it's 20 pct or strike."

In event that the steel strike is settled, major plants will not be able to go back to work. While Jones and Laughlin, National Tube and some of the Carnegie-Illinois facilities have their own power equipment, many other CIO-USWA struck plants in the area are dependent upon Duquesne Light Co. for power.

COMING EVENTS

Feb. 25-28—Annual Meeting, American Institute of Mining and Metallurgical Engineers, Chicago.

Feb. 25-Mar. 1—Spring Meeting, American Society for Testing Materials, Hotel William Penn, Pittsburgh.

Mar. 4—SAE German Engineering Evaluation Meeting, Rackham Educational Memorial, Detroit.

Mar. 5-6—Midwest Quality Control Conference, La Salle Hotel, Chicago.

Mar. 20-22—Production Show and Conference, Chicago Technical Societies Council, Stevens Hotel, Chicago.

Mar. 29-30—American Gas Assn. Conference on Industrial and Commercial Gas, Commodore Perry Hotel, Toledo.

Apr. 2-5—Packaging Exposition, sponsored by American Management Assn., Public Auditorium, Atlantic City, N. J.

Apr. 3-5—SAE National Aeronautical Meeting, Hotel New Yorker, New York.

Apr. 8-12—ASTE Exposition, Cleveland Public Auditorium, Cleveland.

Apr. 11-13—Spring Congress, Electrochemical Society, Inc., Birmingham, Ala.

Apr. 22-27—National Plastics Exposition, Grand Central Palace, New York.

Apr. 25-26 — Twenty-ninth AIME Annual Open-Hearth Steel and Blast Furnace and Raw Materials Conferences, Chicago.

May 6-10—Golden Jubilee Foundry Show, American Foundrymen's Assn., Cleveland Public Auditorium, Cleveland.

May 29-31 — Machine Dealers National Assn., national convention, Claridge Hotel, Atlantic City.

June 2-7—SAE Summer (semi-annual) Meeting, French Lick, Ind.

June 3-5—American Gear Manufacturers Assn., Annual Meeting, The Homestead, Hot Springs, Va.

June 24-28—Forty-ninth Annual Meeting, American Society for Testing Materials, Buffalo.

Weekly Gallup Polls . . .

Voters Think President Turns to Leftward Course

• • • **A growing feeling** throughout the country that Mr. Truman is moving leftward has cost the president considerable support from conservative elements, according to George Gallup, director, American Institute of Public Opinion.

The feeling that he has finally tipped his hand and is going left comes at a time when the American electorate is as nearly middle-of-the-road in its political desires as it is possible to be.

The number of voters who want the government to move toward the left is almost exactly counter-balanced by the number who want it to move to the right, while the majority think it ought to steer a middle course between right and left. There has been no important change in that sentiment for many months.

Mr. Truman was following a middle-of-the-road course in earlier days, most voters thought, but today nearly half the country thinks he is showing greater partiality toward labor and various liberal groups than toward anyone else. This shift as seen by voters has not been accompanied by any particular shift toward the left among voters themselves. This partly explains why the more conservative Democrats and Republicans have been criticizing the President.

To some extent Mr. Truman has also lost support from liberal voting elements who feel that he has not gone far enough to the left. But the defection from that side does not compare in extent with the defection from the conservative side.

The country's opinions about Mr. Truman's policies were sounded through two questions in the institute's survey as follows:

"Which of these three policies would you like to see the government follow: (1) go more to the left by following more of the views of labor and other liberal groups, (2) go more to the right by following more of the views of business and conservative groups, or (3) follow a policy half-way between the two?"

After indicating his choice, each voter was asked: "Which of those three policies do you think the government has been following?"

The results to the first question as shown in this poll and also in a similar poll last September, follow:

	At Present Pct	Sept. Pct
Should go more to left	18	16
Should go more to right	21	18
Should keep middle of road	52	55
No opinion	9	11

A picture of sharp contrast is revealed when voters are asked to give their opinion about which way the Truman Administration is moving.

Whereas fewer than one fifth (18 pct) want the Administration to move to the left, more than twice that number, 44 pct, say they think it is going in that direction now.

Although the majority of all voters want a middle-of-the-road course, only 27 pct think the Administration is steering such a course now. A total of 13 pct think the Administration is moving toward the right, as compared with 21 pct who want it to go in that general direction.

A profound change has occurred since September in the way the country sizes up Mr. Truman's position. Note the contrast in the following table showing the number who thought Truman was going left, right or center last autumn, and the number today.

Opinion Direction Administration is Taking

	At Present Pct	Sept. Pct
Going left	44	10
Going right	13	17
Middle of road	27	54
No opinion	16	19

While President Truman's personal popularity with the voters of the country is considerably lower today than it was during his political "honeymoon" period, he continues to have the approval of a very substantial majority of his fellow citizens.

More than six out of every ten voters polled from coast to coast say they approve in general of the way Mr. Truman is handling his job in the White House. This compares with a favorable vote of more than eight in every ten in a similar poll conducted two months after he assumed office.

The drop in Mr. Truman's popularity has come about mainly, the survey finds, because of a changed attitude among Republican voters, that is people who voted the G. O. P. presidential ticket in 1944. A large majority of these started out with a high regard for Mr. Truman, but have altered their views in recent months as political party lines became more tightly drawn with the ending of the war and problems on the home front have multiplied. Most of the Republicans who now indicate friendliness toward Mr. Truman would not vote for him anyway in preference to a Republican candidate. The politically significant thing about the poll is how Mr. Truman stands with his own party. There has been a much smaller drop in his popularity with Democrats than with Republicans.

Truman's Popularity Declines In More Conservative Circles Handling of Labor Criticized

The country's attitude toward Mr. Truman may be seen in the following tables which give the national vote and the vote by parties.

"Do you approve or disapprove of the way Truman is handling his job as president?"

National Vote

	Approve Pct	Disapprove Pct	No opinion Pct
July, 1945	87	3	10
Oct.	82	9	9
Nov.	75	14	11
TODAY	63	22	15

The main explanation for the drop is seen in the following vote by parties. Note that while there has been some falling off in the Democratic rank and file, the principal shift has come among Republican voters.

By Parties

	Approve Pct	Disapprove Pct	No opinion Pct
REPUBLICANS			
July, 1945	89	3	8
Oct.	75	14	11
Nov.	68	22	10
TODAY	46	37	17
DEMOCRATS			
July, 1945	88	2	10
Oct.	88	5	7
Nov.	80	10	10
TODAY	75	13	12

A coast-to-coast opinion poll by the institute finds that the Presi-

(CONCLUDED ON PAGE 124)

Excess German Plants Going for Reparations

Berlin

By JACK R. HIGHT

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• • • **Four power agreement** on the method of evaluation of German industries on a 1938 adjusted-replacement-cost basis announced here recently will make it possible for the reparations committee to continue the work of allocating excess plants to the new owners. The decision is considered here to be one of the most important agreements yet reached, as it will be the basis for determining what amount of the 15 pct excess capital equipment is to go to Russia and Poland from the western occcupation zones, and thereby also determine what quantities of foodstuffs and other commodities will be received in exchange.

The basic clauses in the agreement reached by the Coordinating Committee of the Allied Control Authority state that plant and equipment shall be evaluated on the basis of 1938 replacement cost in Reichsmarks, without taking into account delivery and installation charges. War damage will be deducted, and depreciation will be deducted at a rate to be agreed upon. A special allowance for abnormal use in wartime will be made by multiplying the depreciation factor by 1.35 for each year of war use. Maximum amount allowable for war damage and depreciation will be 78 pct of the 1938 cost.

According to a recent report of the Military Governor for the American zone further declarations of plants available for reparations, and their allocations await the final four power agreements on the future standard of living of Germany, and the level of operation of German industry. According to the terms of the Potsdam agreement, certain types of plants have already been earmarked for reparations, and in some cases have been evaluated. Table I presents a summary of the plants made available as advance reparations.

As a general rule, after machinery and equipment suitable for reparations is removed, the plants are to be destroyed if they are camouflaged or are underground, but if they are standard construction types useful in peacetime they will be retained.

The 83 industrial establishments which have been settled for reparations represent a measurable part of the German industrial capacity. The estimated reduction in German capacity due to the removal of all plants in the U. S. zone declared available for reparations is indicated in Table II.

As a part of the policy outlined above, war plants are already being dismantled and destroyed, after general purpose machines have been removed for reparations. Among the plants at which the dismantling is already going forward are the following:

Dornier Aircraft Complex,
including 19 plants in Bavaria
Messerschmitt A. G.
including 6 plants at Augsburg
in Bavaria
Norris Zuendlicht A. G.
Nurenberg, Bavaria
Continentale Metall A. G.
Langenaubach, Greater Hesse

TABLE I

Plants Declared Available for Reparations to January 1, 1946

Zone	Plants Declared Available for Reparations	Plants for which Evaluation has Been Completed	Plants for which Allocation has been Agreed Upon
Total	83[a]	28	26[b]
U. S. Zone	25	15	14[b]
British Zone	42	12	11[b]
French Zone	16[a]	1	1

[a] Reduced from 84 to 83 by withdrawal of the former I. G. Farben synthetic dye plant at Ludwigshaven (French Zone).

[b] One plant in the U. S. Zone (the Hahn Kolb machine tool plant) and one plant in the British Zone (the Karl Kunzler oil equipment plant) were not allocated since upon appraisal they were found to be without value.

TABLE II

Estimated Reduction in German Industrial Capacity by Removal of 25 Plants From U. S. Zone*

Industries from which Plants were Taken	Percent of Capacity Removed	
	From U. S. Zone	From All of Germany
Shipbuilding	40	11
Ferro-Nickel	100	100
TNT	38	16
Explosive Chemicals	48	...
Diesel and Gas Engines	7	3
Ball Bearings	40	33
Aircraft Engines	26	10
Motorcycle Engines	70	11
Machine Tools	13	4
Optical Instruments	5	2
Public Utilities	8	2

* Includes all plants declared available for reparations in the U. S. Zone. Does not represent removal of whole plant in all cases.

In addition to the reparations program which is going on the efforts planned for the restitution of recoverable machinery and equipment stolen from the occupied countries during the war is also getting underway. A total of about 400 separate claims had been filed up to the end of last year, and some restitutions have already been made.

Representatives of Belgian, French and Netherlands missions have recently visited the Bayerische Motoren Werke factories to check machinery which had been sold to this firm by German looting companies. The work is being complicated by the fact that the looting companies organized by the Germans sold looted property to manufacturers, invoicing it with the shipping point indicated as the city in which the looting company had its headquarters, rather than the point at which the machinery was shipped.

The claims being received from the Belgian Government consist primarily of machinery, including drill presses, lathes, grinders, jig borers, presses and some rubber producing machinery. A claim for rolling stock, including 22 locomotives, is being held pending a general overall consideration of the transport problem.

Recent claims from France are basically for the same type of equipment, and an inquiry has been received relative to the possible return of 350 locomotives. At present details are being arranged for actual shipment of some released French claims, and technicians are on their way to Germany to supervise crating and movement.

Claims are also being received from Poland, Norway, Netherlands, Czechoslovakia and Yugoslavia, and are being processed at the present time.

Among Industrial Plants Declared Available for Reparations to Jan. 1, 1946, are the following:

Field	Major Product	Name	Location	
			City	Zone
Machinery, Parts and Machine Tools	General Purpose	Hahn Kolb	Stuttgart	U.S.
	Automatic Screws	Hahn Tessky Indexwerke	Esslingen	U.S.
	General Purpose	Bohner & Kohle	Esslingen	U.S.
	Presses and Lathes	Fritz Mueller	Oberesslingen	U.S.
	Ball Bearings	Kugelfischer Georg Schaefer & Co.	Schweinfurt	U.S.
	Diesel Engines	Kloeckner-Humboldt-Duetz	Oberursel	U.S.
	Revolving Drills	Hanwell-Lueg	Duesseldorf	Br.
	Lathes	Waldrich	Siegen	Br.
	Lathes	Schiss-Defris	Duesseldorf	Br.
	Lathes	Wagner	Dortmund	Br.
	Oil Refinery Equipment	Karl Kunzler	Essen	Br.
	Crankshafts	Kurbelwellenwerke	Glinde	Br.
		Fahr Tractor Plant	Gottmadingen	Fr.
		Krammer Tractor Plant	Gottmadingen	Fr.
		Bosch Accessories Plant	Sulz	Fr.
Shipbuilding		Deutsche Schiffs & Maschinenbaus Deschimag Werk A. G.	Weser-Bremen	U.S.
		Bremen Plant	Valentin-Bremen	U.S.
		Blohm & Voss	Hamburg	Br.
		Wilhelmshaven Werft	Wilhelmshaven	Br.
Aircraft	Engines	Underground Aircraft Engine Plant (Daimler Bens)	Obrigheim	U.S.
	Engines	Bayerische Motorenwerke No. 1	Munich	U.S.
	Engines	Bayerische Motorenwerke No. 2	Munich	U.S.
	Parts and Assemblies	Norddeutsche Dornierwerke	Luebeck	Br.
	Parts and Assemblies	Norddeutsche Dornierwerke	Rothbeck	Br.
		Dornierwerke	Friedrichshaven	Fr.
		Dornier	Konstanz	Fr.
	Aviation Material	Sueddeutsche Arguswerke	Baden-Baden	Fr.
	Aviation Material	Sueddeutsche Arguswerke	Dusslingen	Fr.
	Aviation Material	Sueddeutsche Arguswerke	Brombach	Fr.
	Aviation Material	Sueddeutsche Arguswerke	Pfullendorf	Fr.
Armaments	Torpedoes	C. F. Borgeward	Bremen	U.S.
	Shell Loading	Wehrmacht Ordnance	Deschnig	U.S.
	Shell Loading	Wehrmacht Ordnance	Strass	U.S.
	Shell Loading	Wehrmacht Ordnance	Gelting	U.S.
	Small Arms	Metallwerke	Neuengamme	Br.
	Arms	Rinker	Menden	Br.
	Cartridge Cases	Hanseatische Kettenwerke	Hamburg	Br.
	Cartridge Cases	Metallwerke	Wolfenbuettel	Br.
	Mortar Bomb Filling	Salzwerk Riedel (Underground factory in salt mine)	Burgdorf	Br.
	Shells and Grenades	Heeresmunitionsanstalt	Lehre	Br.
	Shells	Heeresmunitionsanstalt	Grasleben-Helmsted	Br.
	Shells	Lufthaupts Munitionsanstalt	Hambuhren	Br.
	Shells	Heeresmunitionsanstalt	Lockstedten Lager	Br.
	Shells and Grenades	Heeresmunitionsanstalt	Bodenteich	Br.
	Shells	Fulbanlage Clauen	Clauen	Br.
	Ammunition	Heeresmunitionsanstalt	Godenau / Alfeld	Br.
	Shells	Lufthaupt Munitionsanstalt	Nienberg / Weser	Br.
	Shells	Heeresmunitionsanstalt	Scheuen	Br.
		Mauser Arms Plant	Oberndorf	Fr.
		Mauser Arms Plant	Vorhingen	Fr.
Metals	Steel	Norddeutsche Huetten A. G.	Bremen	U.S.
	Steel	Huetten Werke Essen Friedrich Krupp A. G.	Borbeck	Br.
	Steel Alloy	Bandeisenwalzwerk	Dinslaken	Br.
	Steel	Krupp	Essen	Br.
	Aluminum Foil	Tscheulin Aluminum Foil Works	Tenningen	Fr.
Power Plants		Gendorf	Gendorf	U.S.
		Gross Kraftwerk	Mannheim	U.S.
		Hastedt Steam Plant	Bremen	U.S.
		Toging	Muehldorf	U.S.

Surplus Sale Includes Turnbuckles and Nuts

Washington

• • • **More than $7** million worth of turnbuckles, bolts, nuts and screws in a wide variety of sizes, shapes and finishes and in indeterminable quantities are being offered in a nationwide sale now underway, the War Assets Corp. has announced. The war surplus is being offered to federal, state and local governments; veterans; dealers; industrial users and exporters, through the regional consumer goods offices maintained by WAC in 11 cities.

It includes 365,000 turnbuckles from size 3/16 by 3 to 2½ by 48 in. the following styles: With and without stubs, hook and eye, hook and hook, eye and eye, jaw and eye, and jaw and jaw. Also included is an indeterminable quantity of bolts, nuts, machine screws, cap screws, set screws, wood screws and stove bolts.

WAC regional offices taking part in the sale include: Boston, New York, San Francisco, Philadelphia, Cincinnati, Chicago, Atlanta, Kansas City, Denver, Seattle and Fort Worth, Tex.

J&L Earnings Show Gain

Pittsburgh

• • • **Jones & Laughlin Steel** Corp. reported net earnings for 1945 of $8,082,082, as compared with $7,966,663 earned in 1944, after adjustments. Fourth quarter earnings in 1945 totaled $2,367,774, as compared with $2,488,629 earned during the same period in 1944.

Streamlining of Peacetime Procurement Policies Is Underway

Washington

By GENE HARDY

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• • • **Streamlining of** the normal peacetime procurement policies of the War, Navy and Treasury Depts. and the Maritime Commission, designed to keep the United States industrially and militarily strong, is now underway.

Many of the details of this joint program are embodied in proposed legislation which will be presented to Congress within the next few weeks. However, a considerable part of the program can be put into effect without additional statutory authority.

The recommended legislation is based largely on the success achieved with many wartime procurement innovations. The emphasis during peacetime will continue to be on negotiated contracts for research and development as well as technical procurement. However, procurement agencies will return to competitive bidding for standard stock and subsistence supplies—those that can be purchased in regular commercial channels and are readily obtainable. Contracts will be placed under competitive bidding procedures when the following conditions are present:

(1) Clear specifications.
(2) The product is widely manufactured.
(3) Proper market conditions as they relate to the law of supply and demand that will result in keen competition for the business.

Negotiated contracts will apply to technical procurement generally, that is, the buying of ideas, research and development projects in universities and industrial plants, supersonic planes, guided missiles, electronics, utilization of atomic power, and other procurement affecting the security of the United States. The areas in which negotiation will be used are clearly defined in the proposed legislation.

The Procurement Policy Board, consisting of representatives from the Treasury Dept., War Dept., Navy Dept., and the Maritime Commission, as well as CPA, SWPC, and OPA, on Nov. 27, 1945, approved unanimously the recommendations of the subcommittee on postwar procurement. The basic recommendation of this committee was that legislation be enacted granting each agency "authority to negotiate prices and award contracts, in such form and type as may be suitable, at the discretion of the heads of the agencies."

Acting on this recommendation a committee composed of representatives of all the above agencies, except CPA and OPA, drafted a single bill to cover all procurement agencies. This bill has since been approved by the War and Navy Depts. and the Maritime Commission and is being considered favorably by the Treasury Dept. Regardless of whether or not merger of the Armed Services is effected, it is believed that the unanimity of opinion expressed by the representatives of the principal procurement agencies will result in legislation that will not be materially affected.

In general, the new procurement policy is based on the fact that, in the postwar period, primary emphasis will be upon the "quality of conception" of weapons which are developed rather than upon large production of these weapons. Much of the procurement, particularly of the War and Navy Depts., will be concerned with contracts for research and development in new or only partially developed fields. It was quickly made clear that in such procurements it will not be possible to draw up detailed specifications which will be relatively fixed during the life of the contract, a condition which is imperative for the operation of a genuine and effective competitive bid system.

It was further recognized that national defense and preparedness cannot be maintained without a vigorous industrial organization. Therefore, postwar government procurement policy is being designed to encourage the growth of independent industrial enterprises with plants distributed over the nation in order to avoid reliance upon a few concentrated sources of major supplies and services.

For a thorough understanding of how this procurement program will operate it is necessary to understand the 15 areas, outlined in the proposed legislation, in which exceptions to competitive bidding

LONG RANGE AIRLINER: *Republic Aviation Corp. claims this new experimental plane the XF-12 has proved itself the fastest long-range four-engine transport type airplane in the world. Officials say details of its speed are still secret, because the plane was designed for the Army as a long-range reconnaissance craft. Upon conversion to a passenger transport, the plane will cruise at 400 mph, at an altitude of 40,000 ft, carrying about 46 passengers, according to the company.*

would be used. While the analysis which follows has been discussed only with the Navy Dept., it is reasonable to assume, because of the joint effort in preparing the legislation and the unanimity of opinion, the other procurement agencies agree with the Navy's interpretation.

The 15 conditions under which the use of negotiated contracts will be requested from Congress follow:

(1) If made during the period of national emergency declared by the President.

(2) If the public exigency will not admit of the delay incident to advertising.

(3) If for personal or professional services.

(4) If the supplies or services are to be procured and used outside the limits of the United States and its possessions. Points 2, 3 and 4 are in line with the existing Competitive Bid Statute.

(5) If the aggregate involved does not exceed $1000. This raises the existing limit from $500 which has proved inadequate.

(6) If for medicines, medical supplies, hospital or surgical supplies or prosthetic appliances.

(7) If for supplies purchased for authorized resale.

(8) If for proprietary supplies, perishable subsistence supplies or other supplies or services for which it is impracticable to secure competition.

(9) If the agency head determines that the purchase or contract is for experimental, developmental or research work for manufacture or furnishing of supplies for experimentation, development, research or test. In these cases, since specifications are usually of a very general nature and subject to frequent change, the procurement must be negotiated to fit the particular situation and the particular contractor.

(10) If for supplies or services as to which the agency head determines that the character, ingredients or components thereof are such that the purchase or contract should not be publicly disclosed. For example, advertising for bidders to furnish a cyclotron, uranium ore, or another Manhattan Project would obviously destroy the required secrecy.

(11) If for supplies as to which the agency head determines that the procurement thereof without advertising is necessary to assure standardization of equipment and interchangeability of parts. For example, the purchase, as a result of battle damage, of the propulsion machinery for one shaft of a battleship and the spares therefor. It would be extremely undesirable, from the Navy's viewpoint, to have three of the shafts of a battleship operated by machinery of one manufacturer and the fourth shaft operated by the equipment of another manufacturer because of the necessity for providing duplicate inventories of spares, separate instruction manuals and maintenance procedures.

(12) If for supplies or services as to which the agency head determines that advertising and competitive bidding would not secure supplies or services of suitable quality. It has been stated that in regard to the quality of products, there are such examples as bomb sights, submarine periscopes and other items where the skill and experience of particular manufacturers are the major guarantees of performance.

(13) If for supplies or services as to which the agency head determines that advertising and competitive bidding does not produce reasonable prices independently arrived at in open competition. For example, where the demand for goods exceeds the available supply.

(14) If the agency head determines that it is in the interests of the national defense that any plant, mine, or facility or any producer, manufacturer or other supplier be made or kept available for furnishing supplies or services in the event of a national emergency, or that the interests either of industrial mobilization in case of such an emergency, or of the national defense in maintaining active engineering, research and development, are otherwise subserved. This exception is designed to give the agency head broad powers to use negotiated procurement as a dynamic instrument of preparedness. It will permit the agency head to take into consideration such factors as geographical location, avoidance of over-concentration in a few companies, maintenance of a basic core of plants, facilities, skills and personnel, around which there can be expansion when urgently needed and like factors.

(15) If otherwise authorized by law. This provision preserves authority provided by existing law.

It is interesting to note that only in rare instances can the authority requested above be delegated below the assistant or undersecretaries of the various departments. The broader the power the more restricted is the authority to delegate.

In addition to the above 15 points the proposed legislation would set up procedures for competitive bid contracts and would guarantee a fair proportion of the total value of all purchases and contracts to small business concerns.

All types of contracts, including fixed price contracts, maximum price contracts, fixed price incentive contracts, cost-plus-fixed-fee contracts and letters of intent, would be used under appropriate conditions. However, the proposed legislation specifically prohibits the use of cost-plus-a-percentage-of-cost contracts.

An increase in the maximum fee on cost-plus-a-fixed-fee production contracts from 7 pct to 10 pct is also recommended. On research and developmental contracts the maximum fee would be 15 pct.

Under the new program, authority is not requested to recapture excessive profits, except in the nature of price redeterminations under contractual provisions.

When self-financing is impossible, the requested legislation would permit advance and progress payments under specified conditions, and when approved by the agency head or the one to whom such authority is delegated.

Coordination of procurement between all government procurement agencies will be continued and furthered through joint procurement, cross procurement, collaboration of buyers, standardization of contractual forms and procedures, and through close liaison at the policy and operating levels.

Finally, the program calls for a plan of organization within the agencies which takes advantage of the lessons learned during wartime and retains a flexibility which would lend itself to rapid expansion in the event of a national emergency.

German Diesel Engine Study Discloses Superior Type of Equipment

Washington

• • • **Preliminary studies of** large German diesel engines employed by the Nazis in the final stages of the European war indicate that American designers have not yet produced equipment of this type superior to German designs, according to a report made public for the first time by Major General Edmond H. Leavey, newly appointed Chief of Transportation, Army Service Forces.

The diesel engine study, prepared by H. J. Kirschner, of the Transportation Corps' Research and Development Div., is based in part on German data seized by overseas technical Intelligence teams and is the first of a series of papers to be released by the Army Transportation Corps analyzing enemy technological advances in the field of transportation.

In addition to publishing the results of its own studies, General Leavey pointed out, the Transportation Corps is offering its collected enemy data to American industry. The invaluable library of handbooks, blueprints, still and motion pictures, operations reports and allied papers has been turned over to the Office of the Publication Board, Room 5843, Commerce Building, Washington, D. C., for general dissemination.

The Army's preliminary report on German diesel engines follows:

"The type of engine built by the industry of any country is subject to its particular requirements and resources; therefore any apparent improvements should be evaluated in light of available manufacturing facilities, materials, manpower, uses and economic conditions. The German engine manufacturers were subsidized heavily by the government under the Hitler regime and available technical skill was funneled into their research laboratories and experimental plants in order to develop highly efficient power plants for the expected war. Since enough information is now available to form a picture of the result of this all-out German endeavor, the following comparative study of high powered combustion engines used by our armed services and Germany has been undertaken.

"In the following table the performance of three popular slow speed, long life, high-powered American diesel engines is compared with the standard German diesel engine of comparative size and application.

Performance of Slow Speed Engines

Engines	A–(U. S.)	B–(U. S.)	C–(U. S.)	German No. 1
Rated BHp	1600	1600	1950	2000
Rpm	750	720	420	520
Weight (lb)	28,000	33,600	98,500	38,500
Space occupied (cu ft)	855	678	1,300	855
Spec. Fuel Consumption, (lb per hp per hr)	0.40	0.36	0.39	0.37

"This comparison shows that the German engine produces 25 pct more power at approximately 31 pct less engine speed with the same average lb per hp ratio and within approximately the same space requirements as our engine No. A.

"In order to compare the basic differences between the engine, the engine characteristics have been tabulated as follows:

Basic Characteristics
Group No. 1

Engines	A–(U. S.)	B–(U. S.)	C–(U. S.)	German No. 1
BHp at Rpm	1600 at 750	1600 at 720	1950 at 420	2000 at 520
Bore and stroke	8¾ x 10½	8⅛ x 10	16 x 20	16 x 18.4
No. Cylinders	16	10	8	6
Displacement	10,100	10,368	32,176	22,100
Cycle	2	2	4	4
Supercharger air pressure (psi)	none	4	7	9
Brake mean effective pressure (psi)	84	85	115	138
Piston speed (fpm)	1310	1200	1400	1600
Hp per cubic inch Displacement	0.159	0.154	0.0605	0.0905
Lb per hp	17½	21.1	50.5	19.25
Hp per cubage	1.87	2.43	1.5	2.34

"It should be pointed out that these data have not yet been established under identical test condition, and may be subject to some corrections. There is, however, evidence available to conclude that the German data are of sufficient reliability to be used for a preliminary comparison.

"The advance of the Germans in producing high horsepower output engines is especially pronounced in the light weight, high speed field. The characteristics of our largest, high-speed, lightweight diesel engine are compared with the standard light weight German diesel engine and an American high-power, high-speed gasoline engine. The comparison of a gasoline engine with a diesel is admittedly not technically correct, but lacking an American light, high-power, diesel engine of nearly equal power, and since this gasoline engine has been used for a very similar application in this country, the comparison seems justified as shown in Table on opposite page.

"From this comparison, it can be readily shown that the German light weight engine has 160 pct more power than the U. S. diesel engine and 40 pct more than the

U. S. gasoline engine. The life of the U. S. engine is, however, considerably longer than that of the German engines. It is interesting to note that the horsepower per cylinder of the German engine is more than twice that of the U. S. built diesel, though the German engine is built on the four cycle and the U. S. on the two cycle principle. In pounds per horsepower, the German is 22 pct lighter than the U. S. diesel. The gasoline engine is 66 pct lighter than the same reference engine. The ratio of hp to space occupied is about the same for both diesel engines, while the gasoline engine shows 18 pct more power per unit of space.

"It is realized that the Germans started several years earlier in both World Wars I and II to prepare for the demands of the military by developing high performance engines. These developments, made at a probable sacrifice of progress in the commercial field, helped to bring out improvements some of which may be uneconomical to adopt by our peace industry. With the unparalleled capacity of our engineers to produce complex machinery in mass production, it appears highly desirable to investigate the basic technical developments of the German designers, with the view of making these advancements practical for mass production and thereby economical for military as well as commercial applications."

Light Weight, High Speed Engines
Performance and Characteristics of High Speed Engines

Engines	U. S. Diesel	U. S. Gasoline	German Diesel
Bhp at Rpm, intermittent rating	960 at 1620	1800 at 2800	2500 at 1630
Bhp at Rpm continuous rating	770 at 1460	1050 at 2000	1875 at 1480
Weight dry in lb, including reduction or reverse gear	4934	3100	10,000
Propeller shaft Rpm, top rating	824	2800	950
Space occupied in cu ft	144	140	370
Life between overhauls in hr	3000	750	400 to 700
Bore and Stroke, in in.	6 x 6½	6⅜ x 6½	7¼ x 9⅞
No. of Cylinders	16	12	20
Displacement in cu in.	2950	2490	8160
Cycle	2	4	4
Supercharger air pressure in in. Hg	34	44	44
Brake mean effective pressure in psi	80	204	149
Piston speed in fpm	1755	3040	2690
Bhp per displacement	0.326	0.724	0.306
Lb per Hp	5.14	1.72	4.0
Hp per cu ft of occupied space	6.66	7.8	6.68
Specific fuel consumption, in lb per hp per hr	0.44–.44	0.50–.66	0.39–.46

New Inoculant For Cast Iron Marketed

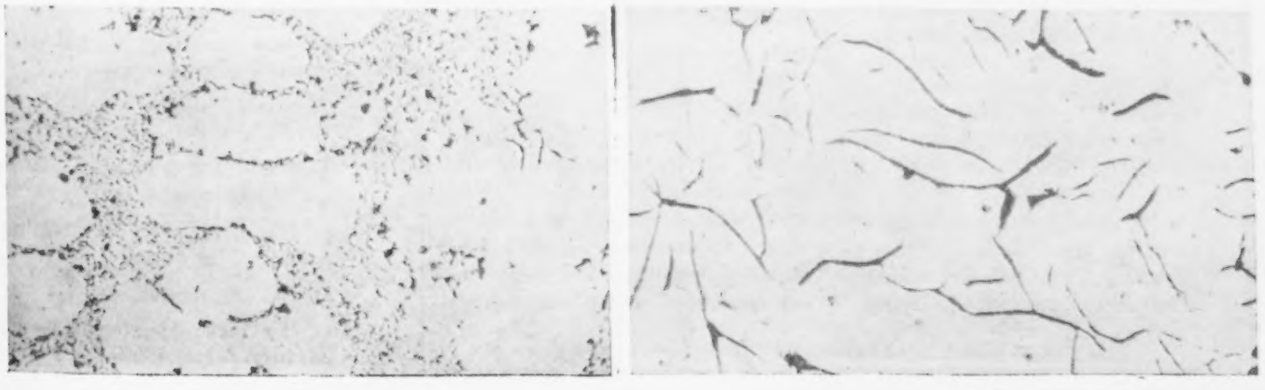
New York

• • • **A new type of** stabilizing inoculant for cast iron has been placed on the market by The International Nickel Co., Inc., here. The inoculant, identified as "F" Nickel Type "B," is reported to control the form and uniform distribution of graphite, to avoid the undesirable and weakening dendritic or pattern arrangement of graphite flakes in cast iron structures, and the inoculant eliminates "hard spots." This is said to result in better machinability, reduces need for annealing and effects a general improvement in the utility of inoculated cast irons.

Containing approximately 60 pct nickel, 30 pct silicon, the balance largely iron, the inoculant combines the above advantages with the strengthening and toughening effect of nickel on iron castings.

This inoculant is a eutectic alloy with a lower melting point than either silicon or nickel alone. This permits it to dissolve readily whether added at the cupola spout or ladle. Additions ranging from 0.5 pct to 1.5 pct may be added to the melt without upsetting the chemistry balance of the base composition, because the ferrite forming power of silicon is held in check by the nickel content which serves to stabilize the austenite or its derivative pearlite. It is said that usually 0.2 pct to 1 pct is all that is required in most instances.

EFFECT OF INOCULANT: *Soft automotive type of cast iron in sections from ½ in. to ¼ in. Unetched, × 250 diam. Left, as cast. Right, inoculated with one pct F nickel type B, better wearing and better machining microstructure.*



Industrial Briefs...

• SCHOOL FOR EMPLOYEES—To meet the need of a thorough educational program in engineering, production, sales, service and factory management for its employees and for its returning veterans, York Corp., York, Pa., has opened its Institute of Refrigeration and Air Conditioning. The only one of its kind in the industry, the school has a potential capacity of 1000 students annually.

• NEW PLANT—Steelcraft Mfg. Co., manufacturers of prefabricated steel and aluminum dwelling houses and agricultural buildings, announced plans for a $250,000 plant to be built at Rossmoyne, Ohio. Approximately 300 persons will be employed on a complete floor space of 25,000 sq. ft.

• AUTO BUILDING—A new automobile and truck agency building will be erected at Middletown, Ohio, at a cost of $100,000. The name of the agency will be Ross Motors, Inc., and work is being speeded so the one-story building will be ready for occupancy by Mar. 1.

• TO DOUBLE CAPACITY—Plans of the Glidden Co. to spend approximately $250,000 in doubling the capacity of its Metal Refining Div., at Hammond, Ind., for the manufacture of iron, copper and lead powders are evidence that producers of powdered metals anticipate a substantial increase in demand for their products. Metals Refining Co. makes both iron and copper powders by reducing the oxides of those metals with gases. This reduction method is one of three principal processes used in the industry. The other two are atomization and electrolytic disposition.

• MERGER — Lectromelt Steel Casting Co. and Barberton Foundry Co. have merged under the name of Lectromelt Casting Co. There will be no change in personnel or management. The company will continue to produce gray iron, and electric carbon steel castings for rubber machinery, tire molds, blast furnaces, rolling mills, machine tool and general jobbing castings.

• MICHIGAN FOUNDRY — With building construction already started, Attwood Iron Industries of Grand Rapids plans to be producing gray iron, semi-steel and ferrous castings by spring. The new plant has a production schedule set at a tentative 20 to 25 tons daily, and that the building and equipment would cost upward of $200,000.

• RECORD CONVERSION — The *Queen Elizabeth*, *Queen Mary*, *Aquitania* and *Mauretania*, the four largest ships available to the allies as troop transports after the burning of the *Normandie*, were armed and converted by Bethlehem Steel Co. in New York Harbor, the Shipbuilding Div. of the company revealed recently. The company also disclosed that it handled a record total of 37,778 ships during the war years.

• ACQUIRES TOOL DIV. — The Davis Boring Tool Div., Larkin Packer Co., Inc., St. Louis, has been acquired by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., manufacturers of horizontal boring, drilling and milling machines.

• RESEARCH FACILITIES — The International Nickel Co. of Canada, Ltd., has announced the formation of a development and research section in Toronto. This section of the company will be staffed by Dr. Gordon S. Farnham, A. S. Tuttle and H. J. Butterill. Its function will be to extend to Canadian industry a complete consulting and technical service on metal problems.

Gallup Polls

(CONTINUED FROM PAGE 117)

dent's chief virtues in the eyes of the people are his honesty and sincerity, his unassuming and friendly manner.

The two questions asked:

(1) What ONE thing do you like best about the way Truman is handling his job?

(2) What ONE thing do you like least about the way Truman is handling his job?

The ten things people said they like best:

(1) The way he is doing his job. His honesty, sincerity and friendliness.

(2) The fact that he is doing the best he can under present conditions.

(3) His carrying on of Roosevelt policies.

(4) His handling of foreign affairs.

(5) His interest in the general welfare, and in the common man.

(6) His handling of strikes and labor difficulties.

(7) The rapidity of demobilization.

(8) His continued attempts to get Congressional cooperation.

(9) His willingness to take sound advice.

(10) His essential independence of attitude.

The ten things people said they like least about Truman:

(1) The way he is handling the labor problem.

(2) His lack of leadership.

(3) The fact that he is too easily influenced, too easily led.

(4) His playing of politics and taking care of his friends in his appointments.

(5) His inability to get along with Congress.

(6) His foreign policy—loans to Britain and Russia.

(7) His failure to take his job seriously enough.

(8) His handling of demobilization.

(9) His poor advisers.

(10) His lack of experience and stature for the job.

Construction Steel...

New York

• • • **The American Institute** of Steel Construction, Inc., announced that the 1945 bookings of fabricated structural steel for bridge and building construction reported by members of the industry, totaled 1,114,087 tons or an increase of 77 pct over the 628,877 tons reported for the year 1944.

Shipments in 1945 also increased to 797,441 tons as compared with 597,872 tons reported in 1944.

December bookings of 108,048 tons declined slightly from the 117,755 tons reported for November.

The reported tonnage available for future fabrication at Dec. 31 has increased to 375,162 tons.

Following is the complete tabulation of bookings and shipments:

Contracts	Tonnage reported to Institute	
closed	1945	1944
Jan.	51,678	45,109
Feb.	62,856	37,477
Mar.	79,730	27,836
Apr.	97,186	61,498
May	52,982	34,840
June	104,283	56,239
July	77,760	90,043
Aug.	97,682	44,740
Sept.	139,420	51,133
Oct.	124,707	80,521
Nov.	117,755	62,437
Dec.	108,048[1]	37,004
Total	1,114,087	628,877
Shipments		
Jan.	57,037	35,163
Feb.	49,002	42,938
Mar.	59,534	41,351
Apr.	62,766	44,495
May	72,626	50,651
June	69,212	43,000
July	69,921	45,328
Aug.	70,637	55,205
Sept.	63,368	57,541
Oct.	76,578	61,554
Nov.	77,993	59,373
Dec.	68,767	61,273
Total	797,441	597,872

Tonnage Available for Fabrication Within the Next Four Months, 375,162

[1] The concerns reporting this month represent 78.3 pct of the total average bookings of the industry during the years 1923-1925.

• • • **Fabricated steel awards** this week included the following:

2700 Tons, Dayton, Ohio, Loose-Wiles Biscuit Co., plant to Bethlehem Steel Co., Bethlehem, Pa.

1500 Tons, Whiting, Ind., generator plant for Standard Oil Co., to American Bridge Co., Pittsburgh, through Stone & Webster Engineering Corp., Boston.

500 Tons, Cambridge, Mass., buildings for National Research Corp., to Lehigh Structural Co.

300 Tons, Minneapolis, addition to General Motors parts warehouse to American Bridge Co., Pittsburgh.

200 Tons, Willimantic, Conn., State Teachers College unit to Electric Boat Co., New London, Conn.

117 Tons, Washington, railroad bridge for Pennsylvania RR. to American Bridge Co., Pittsburgh.

• • • **Fabricated steel inquiries** this week were as follows:

1800 Tons, Lexington, Ky., storage warehouses, P. Lorrilard Co.

1250 Tons, Houston, Tex., hotel-apartment, Stone & Webster, Boston, General Contractor.

875 Tons, Elizabeth, N. J., rte. 25—Sect. 32 A, 16 C highway bridge, New Jersey Highway Dept.

750 Tons, White Oak, Md., cafeteria, auditorium and plastics laboratory, Naval Ordnance Laboratory.

400 Tons, Vernon, Calif., Pacific Press, Inc., warehouse.

135 Tons, Williamsport, Pa., manufacturing building for Vogue Lingerie Co., Lundy Construction Co.

• • • **Reinforcing bar awards** this week included the following:

100 Tons, Briggsville, Mass., cotton spinning mill for Strong, Hewat & Co., to Concrete Steel Co., Boston, through Aberthaw Construction Co., Boston.

• • • **Reinforcing bar inquiries** this week included the following:

2000 Tons, Philadelphia, Inquirer building, Albert Kahn, Detroit, architect.

290 Tons, Glendale, Calif., Rossmoyne District reservoir, Nathan A. Moore, Alhambra, general contractor.

140 Tons, Glendale, Calif., Melwood District reservoir, F. W. Case, Van Nuys, general contractor.

Premium Payments Are Extended by Bill

Washington

• • • **Bearing the names** of nine senators from six western mining states, Senate Bill 1815, to permit continuation of premium payments for copper, lead and zinc, was introduced on Feb. 8. The measure proposes that these payments continue until June 30, 1947.

It is expected that the Senate Bill, as a means of expediting its enactment, will be added as an amendment to the pending House price control bill. The latter was introduced by Representative Spence, D., Ky., chairman of the Committee on Banking and Currency, and proposes extension of price control for another year. It also includes a provision to extend premium price payments on lead, copper and zinc but leaves blank the amounts of premiums to be paid.

The Senate bill on the contrary specifically states the amounts but limits payments to $50 million. The Senate bill provides that the payments will be made on the same terms as heretofore except that all classes of premiums be non-cancellable unless: (1) Necessary in order to make adjustments of income to specific mines, or (2) in order to adjust such a plan to take into account the increasing proportion of civilian purchases and to reduce the cost to the government, the maximum price for each such metal, so long as the maximum price is imposed, shall be increased effective upon enactment of the act, by an amount not less than 60 pct of the initial premium of 5c per lb for copper, 2.75c per lb for lead, and 2.75c per lb for zinc originally established for such metals.

This means that an effort is being made to increase the ceiling prices of the premium metals by legislation. Efforts to get OPA to boost prices have failed. If this measure should pass, the ceiling price of copper would be increased 3c per lb to 15c and the ceilings of lead and zinc would be increased 1.65c per lb to 9.90c per lb and 8.15c per lb, respectively.

These premiums would be confined to companies which have received payments in the past.

Senators sponsoring the bill are McFarland and Hayden, Ariz., Murray, Mont., Johnson, Colo., Thomas and Murdock, Utah, Taylor, Idaho, and Hatch and Chavez, N. Mex.

Carboloy Completes Plant Construction

Detroit

• • • **Carboloy Co., Inc.,** has completed construction of a new plant, located to the north of the present site on Eight Mile Road, and will begin operations in it as soon as equipment has been installed.

The new plant will be devoted exclusively to production of the tungsten carbine metals made by Carboloy. All metal production is being concentrated in this new plant, intended to permit larger scale and more economical mass production of carbide tools, dies and wear resistant parts.

The new plant is technically of one-story type, but actually ceiling height is equivalent to a two-story plant to accommodate the larger equipment planned for it. Conveyors will be extensively used to facilitate handling of the heavy carbide metals and maintain a continuous mass production flow.

The former plant used by Carboloy will now be devoted exclusively to the fabrication of hard metal products. The training school will also be enlarged and facilities expanded for engineering and research.

MACHINE TOOLS

. . . News and Market Activities

Shortages May Cause Plant Shut Down

Cleveland

• • • **Possibility that a** sizable segment of the machine tool industry may be closed down within the next two weeks because of shortages of materials was considered likely by observers here.

Lack of anti-friction bearings and electric motors and controls have closed Warner & Swasey Co. down last weekend for an indefinite period, probably a minimum of two weeks, but more than likely until the equipment can again be made available in quantity.

Company sources disclosed that about 1800 men have been temporarily made idle by this supply situation, and the company is experiencing the circumstance of calling back a limited number of men to work a few days at a time, brought about primarily by delivery pressure, and not by any adequate amount of the materials in short supply. The company's bearing and electrical equipment inventories had reached such low ebb that operation was no longer considered feasible, despite efforts to secure materials from previously untapped and out of the way sources.

With Warner & Swasey, steel was no factor, and one executive pointed out that the company could have continued for at least another two weeks with existing stocks.

Steel castings are rapidly becoming another source of serious concern, with three shutdowns threatened unless other sources of temporary supply can be located. Some observers held that no immediate relief was in sight, as long as the steel strike continues, which, in varying degree, has affected production of the materials, shortage of which bring the builders to a halt.

In the meantime, a backlog of orders is accumulating which will mean extended deliveries, and with possibilities of a long shutdown lurking in the background, sources in the trade feel that Mar. 1 is the absolute deadline for the industry, and by that time, barring a change in the situation, shutdowns among the builders will be widespread.

Adding to the discouraging outlook, strikes have touched a number of machine tool plants, including Van Norman, Gould & Eberhardt, Cincinnati Bickford Tool Co., Hendy Machine Co., Pratt & Whitney, Baker Bros. Inc., Fosdick Machine Tool Co., and a company in Cincinnati which is now starting its fourth week of a strike, although they are no part of the steel industry and their only connection is the fact that their men joined the United Steel Workers in July, 1943, and after repeated attempts at bargaining, no contract was ever made. Yet the workers are out on strike.

Only optimistic link in the week's unhappy chain of events was the rumor, that ceiling may come off machine tools Mar. 1. Several sources in the trade have felt such a move possible, but not imminent, despite the fact that the machine tool prices presumably make no difference in the ultimate cost of living. In light of the competition of the government-owned surplus, at present prices, the industry will have to do something. Wages are a big item with the builders, who once, even before the painful advent of renegotiation, used to figure about one-third for materials, one-third for labor, and one-third for general economic profit. Renegotiation and taxes reduced this to something around 6 pct, by no means a completely comfortable return.

Evidence that some progress has been made on the question of schools and surplus government equipment, is the report that the Farrell, Pa. high school vocational dept. is to receive $80,000 in surplus government machinery and equipment at a cost of less than $2500 to the school district. Farrell also will be the pool center for surplus tools which are to be allotted to schools of the district. Schools requesting tools will be required to post checks with the Farrell officials.

o o o

Steel Strike Starting To Worry Tool Firms

Cincinnati

• • • **Prolongation of the** steel strike and the still unsettled condition of the General Motors strike have increased the perplexities and problems of district machine tool builders. While the flow of materials had been somewhat diminished prior to the present work stoppage, the tie up in the steel industry is becoming daily more serious to the builders here, because of the imminent possibility of their being unable to obtain steel.

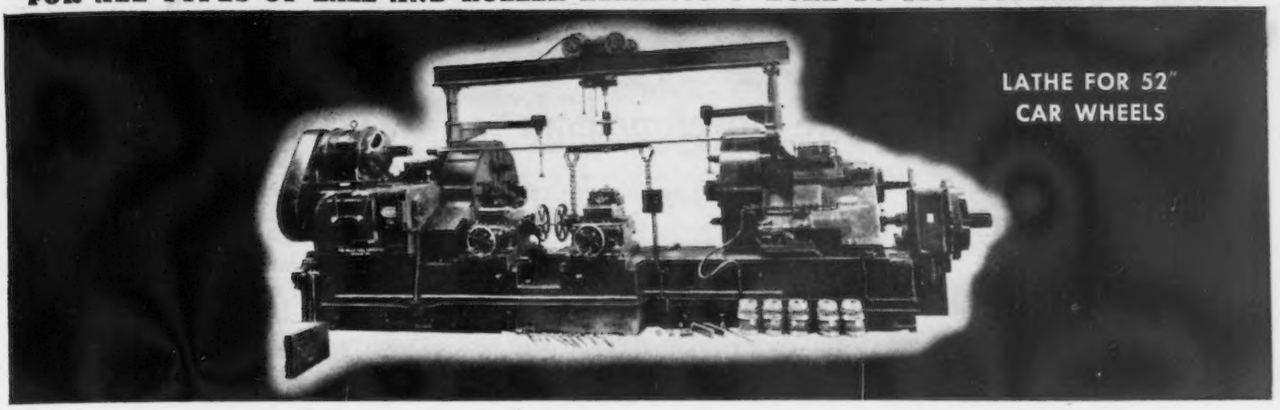
Already a number of manufacturers have indicated that production has been slowed down somewhat, by inability to obtain many of the component parts of the machine tool, such as motors, and controls, and electrical equipment.

In some instances, difficulty in obtaining castings has been reported. With General Motors, a potential market for a substantial quantity of tools, out of production and with the steel industry largely out of production, and therefore unable to get material, machine tool men are feeling that at both ends of their business, they are having extreme troubles.

So far, however, no great curtailment in production because of stoppages has been noted, but discussion among the builders, generally, indicates that they fear the closing of some plants is not in the too far distant future. New business is in moderate quantity, but surplus machines continue to cut into the potential business.

Contact **KAYDON** *of Muskegon*

FOR ALL TYPES OF BALL AND ROLLER BEARINGS 4" BORE TO 120" OUTSIDE DIAMETER



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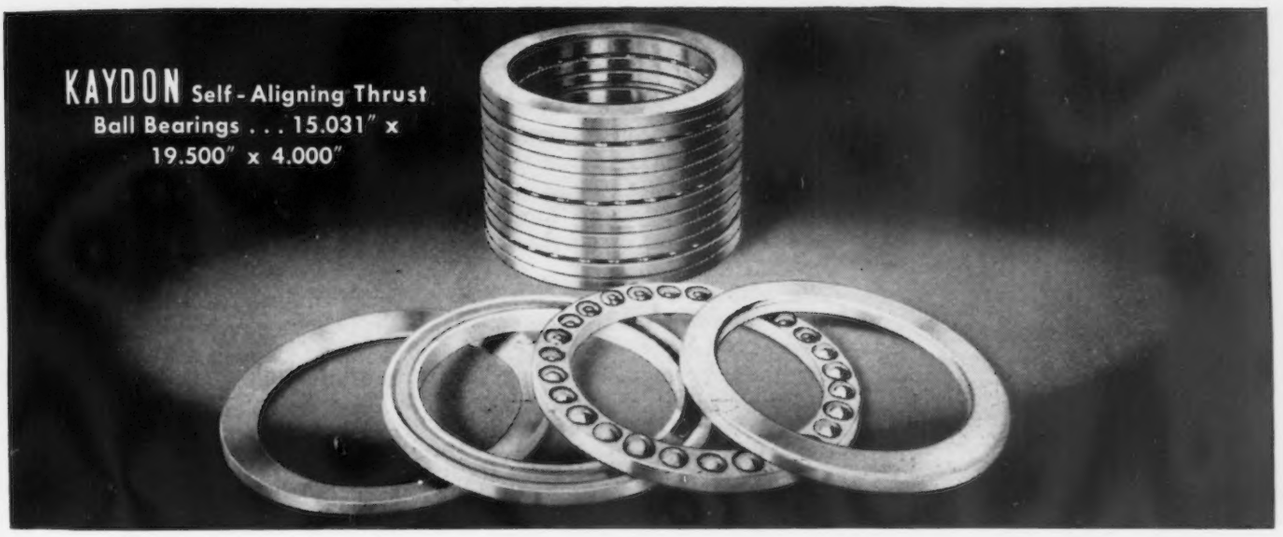

FROM a catalog of the Niles Tool Works Division of the General Machinery Corporation, we quote: "Self-aligning ball thrust bearings take the end thrust on the face plate spindles (of the big Niles 52" Car Wheel Lathe). They absorb but 1/7th of the power consumed through friction by a plain step bearing." KAYDON bearings are doing this job successfully . . . a bearing achievement that suggests the improvements KAYDON is helping engineers attain in many postwar heavy-duty machines, in many industries, through smooth-operating, dependable, precision bearings.

* * *

Counsel in confidence with KAYDON. Capacity now available for production of all types and sizes of KAYDON Bearings. In addition, KAYDON also offers complete facilities for atmospheric-controlled heat treating, flame hardening, precision heat treating, salt-bath and sub-zero conditioning and treatment, microscopy, physical testing and metallurgical laboratory services. Plan now with KAYDON.

KAYDON *Types of Standard or Special Bearings:*
Spherical Roller • Taper Roller
Ball Radial • Ball Thrust
Roller Radial • Roller Thrust

THE KAYDON ENGINEERING CORP.

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NONFERROUS METALS

. . . News and Market Activities

Brass Mill Strike Position Awaits Steel Price-Wage Developments

New York

• • • **The strike of United** Mine, Mill & Smelter Workers (CIO) at the American Brass Co., Scovill Mfg. Co. and Chase Brass & Copper Co. in the Waterbury area has passed its first week without any significant developments. However, with the approaching decision of the steel price wage controversy, it is reasonable to assume that a basis may be established for the solution of the brass mill shutdown. The Bridgeport Brass Co. workers have agreed to accept a 10 pct wage increase and there will be no strike at that plant. Neither are there strikes at the American Brass Co. plant at Kenosha, Wis. or the plants of the Revere Copper & Brass Co.

The figures of the Copper Institute for January show a decrease in crude production to 57,890 tons from a corrected December production of 62,641. This decrease in mine production reflects the closing down of the Utah Copper Co. mines on strike. Deliveries to customers during January are at the rate of 115,601 tons, a figure which does not include the brass mill shutdown. Should the strikes continue and be extended to other mills, it will, of course, seriously reduce subsequent statistics on deliveries. However, in view of the Utah Copper Co. strike, a producer of somewhat less than a third of our domestic copper, it may be expected that these factors will be likely to cancel one another out and current supplies of foreign copper will still be needed.

Negotiations with Chilean copper producers have just been started on the basis of 20,000 tons per month. The outcome of these negotiations hinges on agreement on contract price. Since the agreement among Great Britain, Canada and Rhodesia for all the copper produced by the latter countries, Chile is in a very favorable bargaining position on the matter of price.

The Spence Bill, H R 5270, which has been introduced into the House and is now up for the consideration of the House Banking and Currency Committee, provides for the continuation of premium payments on lead, copper and zinc for another year after June 30 when the current premium payment plan expires.

•

Fix Ore Conversion Costs

Washington

• • • **OPA has issued** amendments fixing maximum prices for the conversion of manganese ore into ferromanganese and for converting ores and concentrates in tungsten, molybdenum, cobalt, and other alloys and metals.

The price in each instance was fixed at the difference between the maximum price of ores or other materials received by the converter and the maximum price of the converted products delivered to the person for whom the conversion service is performed.

•

Lead Continues Short

New York

• • • **The lead picture** remains essentially unchanged with demand well in excess of supply and a continued reduction of the government stockpile. Strikes of miners are still in effect in Mexico and in Utah. Elsewhere, it is reported, there is a gradual easing of the shortage of labor in lead mining. Imports from abroad are at the rate of 10,000 tons per month.

It has become apparent in reports from government quarters that there is no willingness to open the door to larger supplies from domestic mines by freeing lead from the price ceiling. This would, of course, permit non-marginal domestic producers to raise prices to compare with world prices of 7 to 7¼c per lb. Meanwhile, the premium payment plan remains in effect until June 30, at which time it is the presumption of industry members that this arrangement will be continued in an effort to assure the production of unprofitable producers at current ceiling.

Some producers would like to see, in the absence of a free market price on lead, a flat premium payment plan which would remove lead prices from the vagaries of legislative action.

•

Big Metals Stocks Abroad

Washington

• • • **Consisting chiefly** of strategic metals and minerals, including aluminum, zinc, mercury, manganese and copper, personal property held abroad by non-military United States agencies, excepting surplus property, amounted to $150 million on Sept. 30, 1945, according to the Department of Commerce.

The Office of Metals Reserve reported overseas inventories amounting to $39 million. During the three-month period the removal of inventory aluminum held in Canada by OMR accounted for a decline of $21 million in the agency's holdings, the only major change from the period ending June 30, according to a compilation by the clearing office for foreign transactions. Inventories held by OMR are located primarily in Canada ($37 million), while minor amounts are located in Cuba and Mexico.

•

Metals Released by OPA

Washington

• • • **OPA has announced** suspension of price control on a long list of nonferrous metals. The action became effective Feb. 13.

These include: Alumina, barium, beryllium metal (alloys and oxide), bronze powder, cerium, columbium and ferrocolumbium, germanium, illinium, indium, lanthanum, lithium metal and lithium compounds other than salts, neodymium, praseodymium, radium, rhenium, samarium, selenium, tantalum, tellurium, thallium, thorium, titanium metal and alloys, zircon, zirconium metal (oxide, alloys and compounds).

Primary Metals

(Cents per lb, unless otherwise noted)

Aluminum, 99+%, del'd (Min. 10,000 lb)	15.00
Aluminum pig	14.00
Antimony, American, Laredo, Tex.	14.50
Beryllium copper, 3.75-4.25% Be; dollars per lb. contained Be	$17.00
Cadmium, del'd	90.00
Cobalt, 97-99% (per lb)	$1.50 to $1.57
Copper, electro, Conn. valley	12.00
Copper, electro, New York	11.75
Copper, lake	12.00
Gold, U. S. Treas., dollars per oz.	$35.00
Indium, 99.8%, dollars per troy oz.	$ 2.25
Iridium, dollars per troy oz.	$90-$100
Lead, St. Louis	6.35
Lead, New York	6.50
Magnesium, 99.9 + %, carlots	20.50
Magnesium, 12-in. sticks, carlots	27.50
Mercury, dollars per 76-lb flask, f.o.b. New York	$103 to $106
Nickel, electro	35.00
Palladium, dollars per troy oz.	$24.00
Platinum, dollars per oz.	$35.00
Silver, New York, cents per oz.	70.75
Tin, Straits, New York	52.00
Zinc, East St. Louis	8.25
Zinc, New York	8.65

Remelted Metals

(Cents per lb)

Aluminum, No. 12 Fdy. (No. 2)	9.00 to 10.00
Aluminum, deoxidizing No. 2, 3, 4	7.25 to 10.00
Brass ingot	
85-5-5-5 (No. 115)	13.25
88-10-2 (No. 215)	16.75
80-10-10 (No. 305)	16.00
No. 1 Yellow (No. 405)	10.25

Copper, Copper Base Alloys

(Mill base, cents per lb)

	Extruded Shapes	Rods	Sheets
Copper	20.87	....	20.37
Copper, H.R.	....	17.37	....
Copper drawn	....	18.37	....
Low brass, 80%	....	20.40	20.15
High brass	....	....	19.48
Red brass, 85%	....	20.61	20.36
Naval brass	20.37	19.12	24.50
Brass, free cut	....	15.01	....
Commercial bronze, 90%	....	21.32	21.07
Commercial bronze, 95%	....	21.53	21.28
Manganese bronze	24.00	....	28.00
Phos. bronze, A, B, 5%	....	36.50	36.25
Muntz metal	20.12	18.87	22.75
Everdur, Herculoy, Olympic or equal	....	25.50	26.00
Nickel silver, 5%	....	28.75	26.50
Architect bronze	19.12	....	....

Aluminum

(Cents per lb., subject to extras on gage, size, temper, finish, factor number, etc.)

Tubing: 2 in. O.D. x 0.065 in. wall 2S, 40c. (½H); 52S, 61c. (O); 24S, 67½c.

Plate: 0.250 in. and heavier; 2S and 3S, 21.2c.; 52S, 24.3c.; 61S, 22.8c.; 24S, 24.2c.

Flat Sheet: 0.188 in. thickness; 2S and 3S, 22.7c. a lb.; 52S, 26.2c.; 61S, 24.7c.; 24S, 26.7c.

2000-lb. base for tubing; 30,000-lb. base for plate, flat stock.

Extruded Shapes: "As extruded" temper; 2000-lb. base, 2S and 3S, factor No. 1 to 4, 25.5c.; 14S, factor No. 1 to 4, 35c.; 17S, factor No. 1 to 4, 31c.; 24S, factor No. 1 to 4, 34c.; 53S, factor No. 1 to 4, 28c.; 61S, factor No. 1 to 4, 28½c.

The factor is determined by dividing perimeter of shape by weight per lineal foot.

Wire Rod and Bar: Base price; 17ST and 11ST-3, screw machine stock. Rounds: ¼ in., 28½c. per lb.; ½ in., 26c.; 1 in., 24½c.; 2 in., 23c. Hexagonals; ¼ in., 34½c. per lb.; ½ in., 28½c.; 1 in., 25½c.; 2 in., 25½c. 2S, as fabricated, random or standard lengths, ¼ in., 34c. per lb.; ½ in., 25c.; 1 in., 24c.; 2 in., 23c. 24ST, rectangles and squares, random or standard lengths. 0.093-0.187 in. thick by 1.001-2.000 in. wide, 33c. per lb.; 0.751-1.500 in. thick by 2.001-4.000 in. wide, 29c.; 1.501-2.000 in. thick by 4.001-6.000 in. wide, 27½c.

Magnesium

Sheet, rod, tubes, bars, extruded shapes subject to individual quotations. Metal turnings: 100 lb. or more, 46c. a lb.; 25 to 90 lb., 56c.; less than 25 lb., 66c.

NONFERROUS SCRAP METAL QUOTATIONS

†(OPA basic maximum prices, cents per lb., f.o.b. point of shipment, subject to quality, quantity and special preparation premiums—other prices are current quotations)

Copper, Copper Base Alloys

OPA Group 1†

No. 1 wire, No. 1 heavy copper	9.75
No. 1 tinned copper wire, No. 1 tinned heavy copper	9.75
No. 2 wire, mixed heavy copper	8.75
Copper tuyeres	8.75
Light copper	7.75
Copper borings	9.75
No. 2 copper borings	8.75
Lead covered copper wire, cable	6.00*
Lead covered telephone, power cable	6.04
Insulated copper	5.10*

OPA Group 2†

Bell metal	15.50
High grade bronze gears	13.25
High grade bronze solids	11.50*
Low lead bronze borings	11.50*
Babbitt lined brass bushings	13.00
High lead bronze solids	10.00*
High lead bronze borings	10.00*
Red trolley wheels	10.75
Tinny (phosphor bronze) borings	10.50
Tinny (phosphor bronze) solids	10.50
Copper-nickel solids and borings	9.25
Bronze paper mill wire cloth	9.50
Aluminum bronze solids	9.00
Soft red brass (No. 1 composition)	9.00
Soft red brass borings (No. 1)	9.00
Gilding metal turnings	8.50
Contaminated gilded metal solids	8.00
Unlined standard red car boxes	8.25
Lined standard red car boxes	7.75
Cocks and faucets	7.75
Mixed brass screens	7.75
Red brass breakage	7.50
Old nickel silver solids, borings	6.25
Copper lead solids, borings	6.25
Yellow brass castings	6.00
Automobile radiators	7.25
Zincy bronze borings	7.00
Zincy bronze solids	8.00

OPA Group 3†

Fired rifle shells	8.00
Brass pipe	7.25
Old rolled brass	6.75
Admiralty condenser tubes	7.25
Muntz metal condenser tubes	6.75
Plated brass sheet, pipe reflectors	6.25
Manganese bronze solids	7.00[1]
Manganese bronze solids	6.00[2]
Manganese bronze borings	6.25[1]

OPA Group 4†

Refinery brass	4.50*

*Price varies with analysis, [1] Lead content 0.00 to 0.40 per cent. [2] Lead content 0.41 to 1.00 per cent.

Other Copper Alloys

Briquetted Cartridge Brass Turnings	8.625
Cartridge Brass Turnings, Loose	7.875
Loose Yellow Brass Trimmings	7.875

Aluminum*

Plant scrap, segregated

2S solids	8.00
Dural alloys, solids 14, 17, 18, 24S	4.00
25S turnings, dry basis	3.00
Low copper alloys 51, 52, 61, 63S solids	7.25
turnings, dry basis	5.75

Plant scrap, mixed

Solids	4.00
Turnings, dry basis	2.75

Obsolete scrap

Pure cable	8.00
Old sheet and utensils	6.00
Old castings and forgings	5.00
Pistons, free of struts	5.00
Pistons, with struts	3.00
Old alloy sheet	5.00

Magnesium*

Segregated plant scrap

Pure solids and all other solids, exempt Borings and turnings	1.50

Mixed, contaminated plant scrap

Grade 1 solids	3.00
Grade 1 borings and turnings	2.00
Grade 2 solids	2.00
Grade 2 borings and turnings	1.00

*Nominal.

Zinc

New zinc clippings, trimmings	6.50
Engravers, lithographers plates	6.50
Old zinc scrap	4.75
Unsweated zinc dross	5.00
Die cast slab	4.50
New die cast scrap	4.45
Radiator grilles, old and new	3.50
Old die cast scrap	3.00

Lead

Deduct 0.55c. a lb. from refined metal basing point prices or soft and hard lead including cable, for f.o.b. point of shipment price.

Nickel

Ni content 98+%, Cu under ½%, 23¢ per lb.; 90 to 98% Ni, 23¢ per lb. contained Ni.

ELECTROPLATING ANODES AND CHEMICALS

Anodes

(Cents per lb., f.o.b. shipping point in 500 lb. lots)

Copper, frt. allowed	
Cast, oval, 15 in. or longer	25⅛
Electrodeposited	18⅞
Rolled, oval, straight	19⅛
Curved	20⅜
Brass, 80-20, frt. allowed	
Cast, oval, 15 in. or longer	23⅝
Zinc, cast, 99.99, 15 in. or longer	16¼
Nickel, 99 per cent plus, frt. allowed	
Cast	47
Rolled, depolarized	48
Silver, 999 fine	
Rolled, 100 oz. lots, per oz.	80

Chemicals

(Cents per lb., f.o.b. shipping point)

Copper cyanide, 1-5 bbls.	34.00
Copper sulphate, 99.5, crystals, bbls.	7.75
Nickel salts, single, 425 lb. bbls., frt. allowed	13.50
Silver Cyanide, 100 oz. lots, per oz.	0.6083
Sodium cyanide, 96 per cent, domestic, 100 lb. drums	15.00
Zinc cyanide, 100 lb. drums	33.00
Zinc sulphate, 89 per cent, crystals, bbls., frt. allowed	6.35

SCRAP

Scrap Stringency to Stay After Strike

New York

• • • With a majority of scrap-producing plants idle as a result of the steel strike, yard supplies of scrap have dwindled considerably. Major consuming mills are in the market attempting to build up inventories so as to be primed for the poststrike period, but due to low supplies, movement is very slow and dealers are experiencing difficulty in meeting demands.

Government-owned surplus scrap supplies are, to a great extent, tied up in strike-bound plants and hence are not available to alleviate the situation. Pittsburgh, however, reports receipt of such materials in small quantities from the East Coast and Frederick, Md.

Contrary to some reports that scrap might be easier following the steel strike, the nature of scrap flow would indicate that the scrap position will not be changed from what it was in the prestrike period. At that time supplies were tight and consumers were clamoring for material. While industrial scrap did come out for a short time after the steel strike started because of consumer inventories and steel on its way, the converse will be true when the strike ends. Steel consumers at that time must wait until the industry is able to climb to prestrike operating rates which may take from two to four weeks depending on the company and the product.

Prices continue firm—no changes have been reported during the past week.

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PITTSBURGH — With no industrial scrap moving of any consequence and much of the Government-owned scrap from surpluses tied up in strike-bound plants, scrap activities in this district are practically non-existent. Weirton, American Rolling Mill at Butler, and Carnegie-Illinois Steel Corp., plus a few others, are willing to take practically all scrap that can be obtained, but dealers are having difficulty in meeting these demands. Cast scrap is particularly scarce, while turnings are moving in very small quantities. Crushers are paying top price for their material and their margin is very small. Occasional carloads are coming from scrap yards and some Government-owned material is moving from the East Coast and various points such as Frederick, Md., but actually the total movement is not great.

CHICAGO—Shipments took a sharp drop last week as more plants were forced to cut fabricating and manufacturing operations as a result of the steel strike. Shipments now are estimated at about one-third the prestrike level. However, mills are continuing to accept shipments of all prime openhearth grades to holding points outside the plants. Other markets are readily available for turnings, cast iron, and unprepared grades. Prices continue firm.

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PHILADELPHIA — Market conditions have not changed appreciably here in the last three weeks. As reported, two mills continue to receive scrap at locations removed from their plants but another is now taking cast scrap in a similar way, fearing that this scrap may become unobtainable. Dealers continue to point out that mills are likely to be very short of scrap when they reopen. Meanwhile, some shipments continue to move from this area to Pittsburgh.

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DETROIT—The market here is dull. Although mills are continuing to accept scrap shipments, with very few cancellations or curtailments, the supply from factories keeps dwindling. Prices, of course, remain at ceiling. Some sources see very faint indications that mills are becoming somewhat more choosy about receipts, which may reflect the building of reserve scrap stocks to better levels than have prevailed for some time.

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BOSTON—Number of consumers in the market for scrap grew rapidly the past week. Steel mills are competing with foundries for low phos. Despite the scramble to buy, actual shipments are limited due to lack of scrap, and inability of yards to obtain cars promptly when shipable scrap is available adds to the confusion. Yardsmen are under the impression consumers expect a real scrap shortage immediately following the steel strike ending.

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NEW YORK—Scrap is moving very slowly as a result of the steel strike. Consumer mills are taking all they can get, which is not much; dealers are experiencing great difficulty in obtaining scrap, and yard supplies have dropped considerably. Although the tug-boat strike has not seriously hampered movement of scrap as yet, if it continues for a few more days, the effect will be serious. The situation is slightly relieved by the fact that railroad tugs are in operation, although their activity is limited. Luria Bros. was awarded 700 tons landing mat scrap last week, at a price of $14.12, delivered in New York.

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BUFFALO—A brisk demand for cast scrap is a feature of the local market, with enquiries from outside the district a major factor. Supplies remain far below requirements, even though some large consumers are closed by the strike. The flow of industrial scrap is getting closer to the vanishing point as more plants curtail or suspend operations because of depleted steel inventories. All the big consumers here are still embargoed, but some shipments have been made to the Valley. Railroad lists are much smaller than usual, and competition is reported keen for these offerings at ceiling prices.

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ST. LOUIS—Openhearth furnaces in the St. Louis industrial district continue to accept all scrap iron that is being offered to them, but the movement is not heavy. The market continues strong, with prices unchanged. The volume of scrap moving by truck from farms and off highways is small, and supplies are accumulating. Laclede Steel Co. and Keystone Steel & Wire Co. are the only plants in the area operating at full capacity.

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CINCINNATI—The scrap market is tight with supply seeming to recede somewhat, but buyers still active. Steel rails and castings are in most active demand, and despite the fact that brokers and dealers are moving all offerings in all grades, they report that more material could be moved if it were available. Prices continue to remain firm.

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CLEVELAND—Where storage facilities permit, some consumers in the Valley are continuing to take shipments. Because of near-normal inventories accumulated at some of the mills since the start of the strike, overall demand has lessened, but mills that are not strike-bound are continuing to accept all offerings. A good deal of scrap has been stored on track locally, and indications are that most consumers will go into the poststrike period in good shape. Production scrap is practically non-existant and interest centers primarily on ordnance scrap scattered throughout the district including Toledo, Lima and Ravenna.

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BIRMINGHAM—Mills here are continuing to place orders for openhearth and blast furnace material to be delivered after operations are resumed. The labor situation at dealers' yards has shown some easing but rainy weather has hindered collection and preparation.

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TORONTO—Practically no change developed in the Canadian scrap iron and steel markets during the week. Dealers continue to complain of shortages and are unable to fill more than 25 pct of current requirements. Dealers' receipts are steadily dropping off and no materials are appearing from the rural districts. Industrial scrap also is on the decline as a result of curtailed operations in a number of plants due to steel shortages, partly caused by the United States steel strike. Canadian mills are rapidly depleting their scrap reserves and have been steadily reducing consumption of scrap in pig iron and steelmaking operations. Only occasional small lots of cast scrap and stove plate are appearing.

Going prices as obtained in the trade by IRON AGE editors, based on representative tonnages. Where asterisks are used on quotations below, this indicates a ceiling price to which must be added brokerage fee and adjusted freight.

PITTSBURGH

Per gross ton delivered to consumer:

No. 1 hvy. melting	$20.00*
RR. hvy. melting	21.00*
No. 2 hvy. melting	20.00*
RR. scrap rails	21.50*
Rails 3 ft. and under	23.50*
No. 1 comp'd sheets	20.00*
Hand bdld. new shts.	20.00*
Hvy. axle turn.	19.50*
Hvy. steel forge turn.	19.50*
Mach. shop turn.	15.00*
Short shov. turn.	17.00*
Mixed bor. and turn.	15.00*
Cast iron borings	16.00*
Hvy. break cast.	16.50*
No. 1 cupola	20.00*
RR. knuck. and coup.	24.50*
RR. coil springs	24.50*
Rail leaf springs	24.50*
Rolled steel wheels	24.50*
Low phos. bil. crops	25.00*
Low phos.	22.50*
RR. malleable	22.00*

CHICAGO

Per gross ton delivered to consumer:

No. 1 hvy. melting	$18.75*
No. 2 hvy. melting	18.75*
No. 1 bundles	18.75*
No. 2 dealers' bndls.	18.75*
Bundled mach. shop turn.	18.75*
Galv. bundles	16.75*
Mach. shop turn.	13.75*
Short shovels, turn.	15.75*
Cast iron borings	14.75*
Mix. borings & turn.	13.75*
Low phos. hvy. forge	23.75*
Low phos. plates	21.25*
No. 1 RR. hvy. melt.	19.75*
Reroll rails	22.25*
Miscellaneous rails	20.25*
Angles & splice bars	22.25*
Locomotive tires, cut	24.25*
Cut bolsters & side frames	22.25*
Standard stl. car axles	25.75*
No. 3 steel wheels	23.25*
Couplers & knuckles	23.25*
Agricul. malleable	22.00*
RR. malleable	22.00*
No. 1 mach. cast.	20.00*
Rails 3 ft. and under	22.25*
No. 1 agricul. cast.	20.00*
Hvy. breakable cast.	16.50*
RR. grate bars	15.25*
Cast iron brake shoes	15.25*
Stove plate	19.00*
Clean auto cast.	20.00*
Cast iron carwheels	20.00*

CINCINNATI

Per gross ton delivered to consumer:

No. 1 hvy. melting	$19.50*
No. 2 hvy. melting	19.50*
No. 1 bundles	19.50*
No. 2 bundles	19.50*
Mach. shop turn.	$10.50 to 11.00
Shoveling turn.	12.50 to 13.00
Cast iron borings	11.50 to 12.00
Mixed bor. & turn.	11.50 to 12.00
Low phos. plate	22.00*
No. 1 cupola cast.	20.00*
Hvy. breakable cast.	16.50*
Stove plate	19.00*
Scrap rails	21.00*

BOSTON

Dealers' buying prices per gross ton, f.o.b. cars

No. 1 hvy. melting	$15.05*
No. 2 hvy. melting	15.05*
No. 1 and 2 bundles	15.05*
Busheling	15.05*
Turnings, shovelings	12.05*
Machine shop turn.	10.05*
Mixed bor. & turn.	10.05*
Cl'n cast, chem. bor.	$13.06 to 14.15*

Truck delivery to foundry

Machinery cast.	21.00 to 23.51*
Breakable cast	21.57 to 21.87*
Stove plate	20.00 to 23.51*

DETROIT

Per gross ton, brokers' buying prices:

No. 1 hvy. melting	$17.32*
No. 2 hvy. melting	17.32*
No. 1 bundles	17.32*
New busheling	17.32*
Flashings	17.32*
Mach. shop turn.	12.32*
Short shov. turn.	14.32*
Cast iron borings	13.32*
Mixed bor. & turn.	12.32*
Low phos. plate	19.82*
No. 1 cupola cast	20.00*
Charging box cast.	19.00*
Hvy. breakable cast.	16.50*
Stove plate	19.00*
Automotive cast	20.00*

PHILADELPHIA

Per gross ton delivered to consumer:

No. 1 hvy. melting	$18.75*
No. 2 hvy. melting	18.75*
No. 2 bundles	18.75*
Mach. shop turn.	13.75*
Shoveling turn.	15.75*
Cast iron borings	14.75*
Mixed bor. & turn.	13.75*
No. 1 cupola cast	20.00*
Hvy. breakable cast	16.50*
Cast, charging box	19.00*
Hvy. axle forge turn.	18.25*
Low phos. plate	21.25*
Low phos. punchings	21.25*
Billet crops	21.25*
RR. steel wheels	23.25*
RR. coil springs	23.25*
RR. malleable	22.00*

ST. LOUIS

Per gross ton delivered to consumer:

Heavy melting	$17.50*
Bundled sheets	17.50*
Mach. shop turn.	12.50*
Locomotive tires, uncut.	$18.50 to 19.00
Misc. std. sec. rails	19.00*
Rerolling rails	21.00*
Steel angle bars	21.00*
Rails 3 ft. and under	21.50*
RR. springs	22.00*
Steel car axles	24.50*
Stove plate	19.00*
Grate bars	15.25*
Brake shoes	15.25*
RR. malleable	22.00*
Cast iron carwheels	20.00*
No. 1 mach'ery cast	20.00*
Breakable cast	16.50*

BIRMINGHAM

Per gross ton delivered to consumer:

No. 1 hvy. melting	$17.00*
No. 2 hvy. melting	17.00*
No. 2 bundles	17.00*
No. 1 busheling	17.00*
Long turnings	12.00*
Shoveling turnings	14.00*
Cast iron borings	13.00*
Bar crops and plate	$18.50 to 19.50*
Structural and plate	18.50 to 19.50*
No. 1 cast	20.00*
Stove plate	19.00*
Steel axles	18.50*
Scrap rails	18.50
Rerolling rails	20.50*
Angles & splice bars	20.50 to 21.00
Rails 3 ft. & under	21.00*
Cast iron carwheels	17.50 to 18.00

YOUNGSTOWN

Per gross ton delivered to consumer:

No. 1 hvy. melting	$20.00*
No. 2 hvy. melting	20.00*
Low phos. plate	22.50*
No. 1 busheling	20.00*
Hydraulic bundles	20.00*
Mach. shop turn.	15.00*
Short shovel. turn.	17.00*
Cast iron borings	16.00*

NEW YORK

Brokers' buying prices per gross ton, on cars:

No. 1 hvy. melting	$15.33*
No. 2 hvy. melting	15.33*
Comp. black bundles	15.33*
Comp. galv. bundles	13.33*
Mach. shop turn.	10.33*
Mixed bor. & turn.	10.33*
Shoveling turn.	12.33*
No. 1 cupola cast	20.00*
Hvy. breakable cast	16.50*
Charging box cast	19.00*
Store plate	19.00*
Clean auto cast	20.00*
Unstrip. motor blks.	17.50*
Cl'n chem. cast bor.	14.33*

BUFFALO

Per gross ton delivered to consumer:

No. 1 hvy. melting	$19.25*
No. 1 bundles	19.25*
No. 2 bundles	19.25*
No. 2 hvy. melting	19.25*
Mach. shop turn.	14.25*
Shoveling turn.	16.25*
Cast iron borings	14.25*
Cast iron borings	15.25*
Mixed bor. & turn.	14.25*
Stove plate	19.00*
Low phos. plate	21.75*
Scrap rails	20.75*
Rails 3 ft. & under	22.75*
RR. steel wheels	23.75*
Cast iron car wheels	20.00*
RR. coil & leaf spgs.	23.75*
RR. knuckles & coup.	23.75*
RR. malleable	22.00*
No. 1 busheling	19.25*

CLEVELAND

Per gross ton delivered to consumer:

No. 1 hvy. melting	$19.50*
No. 2 hvy. melting	19.50*
Compressed sheet stl.	19.50*
Drop forge flashings	19.00
No. 2 bundles	19.50*
Mach. shop turn.	14.50*
Short shovel.	16.50*
No. 1 busheling	19.50*
Steel axle turn.	19.00*
Low phos. billet and bloom crops	24.50*
Cast iron borings	15.50*
Mixed bor. & turn.	14.50*
No. 2 busheling	17.00*
No. 1 machine cast	20.00*
Railroad cast	20.00*
Railroad grate bars	15.25*
Stove plate	19.00*
RR. hvy. melting	20.50*
Rails 3 ft. & under	23.00*
Rails 18 in. & under	24.25*
Rails for rerolling	23.00*
Railroad malleable	22.00*
Elec. furnace punch	22.00*

SAN FRANCISCO

Per gross ton delivered to consumer:

RR. hvy. melting	$15.00 to 15.75
No. 1 hvy. melting	15.00 to 15.75
No. 2 hvy. melting	14.00 to 14.75
No. 2 bales	12.50 to 13.25
No. 3 bales	8.50 to 9.25
Mach. shop turn.	7.00
Elec. furn. 1 ft. und.	15.50 to 17.00
No. 1 cupola cast	19.00 to 21.00

LOS ANGELES

Per gross ton delivered to consumer:

No. 1 hvy. melting	$13.00 to $14.25
No. 2 hvy. melting	12.00 to 13.25
No. 1 bales	12.00 to 13.00
No. 2 bales	11.00 to 12.00
No. 3 bales	8.00 to 9.00
Mach. shop turn.	4.50
No. 1 cupola cast	19.00 to 21.00

SEATTLE

Per gross ton delivered to consumer:

RR. hvy. melting	$10.00
No. 1 & No. 2 hvy. melting	10.00
Elec. furn. 1 ft. und.	$14.00 to 15.00
No. 1 cupola cast	20.00*

HAMILTON, ONT.

Per gross ton delivered to consumer:

Heavy melting	$17.50*
No. 1 bundles	17.50*
No. 2 bundles	17.00*
Mixed steel scrap	15.50*
Rails, remelting	18.50*
Rails, rerolling	21.50*
Bushelings	13.00*
Mixed borings & turnings	12.50*
Electric furnace bundles	20.50*
Manganese steel scrap	20.00*
No. 1 cast	19.00*
Stove plate	17.50*
Car wheels, cast	19.50*
Malleable iron	16.00*

Comparison of Prices . .

[Advances over past week in **Heavy Type**; declines in *Italics*. Prices are f.o.b. major basing points. The various basing points for finished and semifinished steel are listed in the detailed price tables.]

Flat-Rolled Steel: (cents per pound)	Feb. 12, 1946	Feb. 5, 1946	Jan. 8, 1946	Feb. 13, 1945
Hot-rolled sheets	2.20	2.20	2.20	2.10
Cold-rolled sheets	3.05	3.05	3.05	3.05
Galvanized sheets (24 ga.)	3.70	3.70	3.70	3.50
Hot-rolled strip	2.10	2.10	2.10	2.10
Cold-rolled strip	2.80	2.80	2.80	2.80
Plates	2.25	2.25	2.25	2.10
Plates, wrought iron	3.80	3.80	3.80	3.80
Stain's c-r strip (No. 302)	28.00	28.00	28.00	28.00
Tin and Terneplate: (dollars per base box)				
Tinplate, standard cokes	$5.00	$5.00	$5.00	$5.00
Tinplate, electrolytic	4.50	4.50	4.50	4.50
Special coated mfg. ternes	4.30	4.30	4.30	4.30
Bars and Shapes: (cents per pound)				
Merchant bars	2.25	2.25	2.25	2.15
Cold-finished bars	2.75	2.75	2.75	2.65
Alloy bars	2.70	2.70	2.70	2.70
Structural shapes	2.10	2.10	2.10	2.10
Stainless bars (No. 302)	24.00	24.00	24.00	24.00
Wrought iron bars	4.40	4.40	4.40	4.40
Wire and Wire Products: (cents per pound)				
Bright wire	2.75	2.75	2.75	2.60
Wire nails	2.90	2.90	2.90	2.55
Rails: (dollars per gross ton)				
Heavy rails	$43.00	$43.00	$43.00	$40.00
Light rails	45.00	45.00	45.00	40.00
Semifinished Steel: (dollars per gross ton)				
Rerolling billets	$36.00	$36.00	$36.00	$34.00
Sheet bars	36.00	36.00	36.00	34.00
Slabs, rerolling	36.00	36.00	36.00	34.00
Forging billets	42.00	42.00	42.00	40.00
Alloy blooms, billets, slabs	54.00	54.00	54.00	54.00
Wire Rods and Skelp: (cents per pound)				
Wire rods	2.15	2.15	2.15	2.00
Skelp	1.90	1.90	1.90	1.90

Pig Iron: (per gross ton)	Feb. 12, 1946	Feb. 5, 1946	Jan. 8, 1946	Feb. 13, 1945
No. 2 foundry, Phila.	$27.59	$27.59	$27.59	$25.84
No. 2, Valley furnace	25.75	25.75	25.75	24.00
No. 2, Southern, Cin'ti	26.19	26.19	26.19	24.44
No. 2, Birmingham	22.13	22.13	22.13	20.38
No. 2 foundry, Chicago†	25.75	25.75	25.75	24.00
Basic, del'd eastern Pa.	27.09	27.09	27.09	25.34
Basic, Valley furnace	25.25	25.25	25.25	23.50
Malleable, Chicago†	25.75	25.75	25.75	24.00
Malleable, Valley	25.75	25.75	25.75	24.00
L. S. charcoal, Chicago	42.34	42.34	42.34	37.34
Ferromanganese‡	135.00	135.00	135.00	135.00

† The switching charge for delivery to foundries in the Chicago district is 60¢ per ton.
‡ For carlots at seaboard.

Scrap: (per gross ton)				
Heavy melt'g steel, P'gh.	$20.00	$20.00	$20.00	$20.00
Heavy melt'g steel, Phila.	18.75	18.75	18.75	18.75
Heavy melt'g steel, Ch'go	18.75	18.75	18.75	18.75
No. 1 hy. comp. sheet, Det.	17.32	17.32	17.32	17.32
Low phos. plate, Youngs'n	22.50	22.50	22.50	22.50
No. 1 cast, Pittsburgh	20.00	20.00	20.00	20.00
No. 1 cast, Philadelphia	20.00	20.00	20.00	20.00
No. 1 cast, Chicago	20.00	20.00	20.00	20.00
Coke, Connellsville: (per net ton at oven)				
Furnace coke, prompt	$7.50	$7.50	$7.50	$7.00
Foundry coke, prompt	9.00	9.00	9.00	8.25
Nonferrous Metals: (cents per pound to large buyers)				
Copper, electro., Conn.	12.00	12.00	12.00	12.00
Copper, Lake	12.00	12.00	12.00	12.00
Tin, Straits, New York	52.00	52.00	52.00	52.00
Zinc, East St. Louis	8.25	8.25	8.25	8.25
Lead, St. Louis	6.35	6.35	6.35	6.35
Aluminum, virgin, del'd.	15.00	15.00	15.00	15.00
Nickel, electrolytic	35.00	35.00	35.00	35.00
Magnesium, ingot	20.50	20.50	20.50	20.50
Antimony, Laredo, Tex.	14.50	14.50	14.50	14.50

Composite Prices . .

[Starting with the issue of Apr. 22, 1943, the weighted finished steel index was revised for the years 1941, 1942 and 1943. See explanation of the change on p. 90 of the Apr. 22, 1943, issue. Index revised to a quarterly basis as of Nov. 16, 1944; for details see p. 98 of that issue. The finished steel composite prices for the current quarter are an estimate based on finished steel shipments for the previous quarter. These figures will be revised when the actual data of shipments for this quarter are compiled.]

	FINISHED STEEL	PIG IRON	SCRAP STEEL
Feb. 12, 1946	2.44076¢ per lb.	$25.37 per gross ton	$19.17 per gross ton
One week ago	2.44076¢ per lb.	$25.37 per gross ton	$19.17 per gross ton
One month ago	2.44076¢ per lb.	$25.37 per gross ton	$19.17 per gross ton
One year ago	2.38444¢ per lb.	$23.61 per gross ton	$19.17 per gross ton

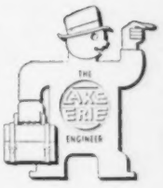
	HIGH		LOW		HIGH	LOW	HIGH	LOW
1945	2.44076¢ Oct.	2	2.38444¢ Jan.	2	$25.37 Oct. 23	$23.61 Jan. 2	$19.17	$19.17
1944	2.30837¢ Sept.	5	2.21189¢ Oct.	5	$23.61	$23.61	19.17	$15.67 Oct. 24
1943	2.29176¢		2.29176¢		23.61	23.61	19.17	$19.17
1942	2.28249¢		2.28249¢		23.61	23.61	19.17	19.17
1941	2.43078¢		2.43078¢		$23.61 Mar. 20	$23.45 Jan. 2	$22.00 Jan. 7	$19.17 Apr. 10
1940	2.30467¢ Jan.	2	2.24107¢ Apr.	16	23.45 Dec. 23	22.61 Jan. 2	21.83 Dec. 30	16.04 Apr. 9
1939	2.35367¢ Jan.	3	2.26689¢ May	16	22.61 Sept. 19	20.61 Sept. 12	22.50 Oct. 3	14.08 May 16
1938	2.58414¢ Jan.	4	2.27207¢ Oct.	18	23.25 June 21	19.61 July 6	15.00 Nov. 22	11.00 June 7
1937	2.58414¢ Mar.	9	2.32263¢ Jan.	4	23.25 Mar. 9	20.25 Feb. 16	21.92 Mar. 30	12.67 June 8
1936	2.32263¢ Dec.	28	2.05200¢ Mar.	10	19.74 Nov. 24	18.73 Aug. 11	17.75 Dec. 21	12.67 June 9
1935	2.07642¢ Oct.	1	2.06492¢ Jan.	8	18.84 Nov. 5	17.83 May 14	13.42 Dec. 10	10.33 Apr. 29
1934	2.15367¢ Apr.	24	1.95757¢ Jan.	2	17.90 May 1	16.90 Jan. 27	13.00 Mar. 13	9.50 Sept. 25
1933	1.95578¢ Oct.	3	1.75836¢ May	2	16.90 Dec. 5	13.56 Jan. 3	12.25 Aug. 8	6.75 Jan. 3
1932	1.89196¢ July	5	1.83901¢ Mar.	1	14.81 Jan. 5	13.56 Dec. 6	8.50 Jan. 12	6.43 July 5
1931	1.99626¢ Jan.	13	1.86586¢ Dec.	29	15.90 Jan. 6	14.79 Dec. 15	11.33 Jan. 6	8.50 Dec. 29
1930	2.25488¢ Jan.	7	1.97319¢ Dec.	9	18.21 Jan. 7	15.90 Dec. 16	15.00 Feb. 18	11.25 Dec. 9
1929	2.31773¢ May	28	2.26498¢ Oct.	29	18.71 May 14	18.21 Dec. 17	17.58 Jan. 29	14.08 Dec. 8

Weighted index based on steel bars, shapes, plates, wire, rails, black pipe, hot and cold-rolled sheets and strip, representing 78 pct of the United States output. Index recapitulated in Aug. 28, 1941, issue.

Based on averages for basic iron at Valley furnaces and foundry iron at Chicago, Philadelphia, Buffalo, Valley and Birmingham.

Based on No. 1 heavy melting steel scrap quotations to consumers at Pittsburgh, Philadelphia and Chicago.

How a 200-ton Metal Working Press is helping to solve the Farm Problem



Farmers need new machinery—lots of it—in a hurry. That's why a prominent farm implement manufacturer installed this modern Lake Erie Hydraulic Press... to produce new farm machinery better—faster—more abundantly.

Lake Erie Hydraulic Presses are noted for their ability to meet critical production problems. Their modern design, rugged construction, precision control and *fast operation* improve production efficiency...lower costs...*answer many problems now confronting industry.*

The design and construction of industrial hydraulic presses is Lake Erie's specialty—has been for years. No matter what your needs, Lake Erie engineers can meet them...quickly...usually with a standard model...but with a special model if necessary. Let us know your hydraulic press requirements today.

Illustrated is the 200-Ton Hydraulic Press which features:

- ★ Extra heavy "C" Frame construction for minimum deflection.
- ★ Rigidly guided platen. Welded steel housing.
- ★ 35-ton cushion in bed.
- ★ Sensitive control of speed by direct stroking of pump.
- ★ Control by hand lever readily accessible to operator.

Press has a 42" right to left and 24" front to back die space, 30" daylight and 16" stroke. Closing speed 350" per minute. Return speed 345" per minute.

LAKE ERIE
ENGINEERING CORP.
BUFFALO, N.Y. U.S.A.

LAKE ERIE ENGINEERING CORP., 368 Woodward Ave., Buffalo 17, N. Y.
Offices in Principal Cities and Foreign Countries

● Leading manufacturer of hydraulic presses...all sizes and types...metal working...processing...plastic molding...rubber vulcanizing...stereotyping...special purpose.

Iron and Steel Prices . . .

Steel prices shown here are f.o.b. basing points, in cents per pound or dollars per gross ton. Extras apply. Delivered prices do not reflect 3 pct tax on freight. (1) Mill run sheet, 10¢ per 100 lb under base; primes, 25¢ above base. (2) Unassorted commercial coating. (3) Widths up to 12-in. inclusive. (4) 0.25 carbon and less. (5) Applies to certain width and length limitations. (6) For merchant trade. (7) For straight length material only from producer to consumer. Discount of 25¢ per 100 lb to fabricators. (8) Also shafting. For quantities of 20,000 lb. to 39,999 lb. (9) Carload lot in manufacturing trade. (10) Prices do not apply if rail and water is not used. (11) Boxed. (12) This base price for annealed, bright finish wires, commercial spring wire. (13) Produced to dimensional tolerances in AISI Manual Sect. 6. (14) Billets only. (15) 9/32 in. to 47/64 in., 0.15c. per lb higher.

Basing Points	Pittsburgh	Chicago	Gary	Cleveland	Birmingham	Buffalo	Youngstown	Sparrows Point	Granite City	Middletown, Ohio	Gulf Ports, Cars	10 Pacific Ports, Cars	DELIVERED TO Detroit	New York	Philadelphia
INGOTS															
Carbon, rerolling	($31.00 f.o.b. mill)														
Carbon, forging	$36	$36	$36	$36	$36	$36	$36								
Alloy	$45	$45				$45	(Bethlehem, Massillon, Canton, Coatesville—$45)								
BILLETS, BLOOMS, SLABS							(Provo—$47.20, Duluth—$38[14])								
Carbon, rerolling	$36	$36	$36	$36	$36	$36	$36	$36				$48[14]	$38		
							(Provo—$53.20, Duluth—$44[14])								
Carbon, forging	$42	$42	$42	$42	$42	$42	$42					$54[14]	$44		
Alloy	$54	$54				$54	(Bethlehem, Massillon, Canton—$54)						$56		
SHEET BARS	$36	$36		$36		$36	$36	$36	(Canton—$36)						
PIPE SKELP	1.90¢	1.90¢					1.90¢	1.90¢	(Coatesville—1.90¢)						
WIRE RODS[15]															
No. 5 to 9/32 in.	2.15¢	2.15¢		2.15¢	2.15¢	(Worcester—2.25¢)					2.40¢	2.65¢			
SHEETS															
Hot-rolled	2.20¢	2.20¢	2.20¢	2.20¢	2.20¢	2.20¢	2.20¢	2.20¢	2.30¢	2.20¢		2.75¢	2.30¢	2.44¢	2.37¢
Cold-rolled[1]	3.05¢	3.05¢	3.05¢	3.05¢		3.05¢	3.05¢		3.15¢	3.05¢		3.70¢	3.15¢	3.39¢	3.37¢
Galvanized (24 gage)	3.70¢	3.70¢	3.70¢		3.70¢	3.70¢	3.70¢	3.70¢	3.80¢	3.70¢		4.25¢		3.94¢	3.87¢
Enameling (20 gage)	3.45¢	3.45¢	3.45¢	3.45¢			3.45¢		3.55¢	3.45¢		4.10¢	3.55¢	3.81¢	3.77¢
Long ternes[2]	3.80¢	3.80¢	3.80¢									4.55¢		4.16¢	4.12¢
STRIP															
Hot-rolled[3]	2.10¢	2.10¢	2.10¢	2.10¢	2.10¢		2.10¢			2.10¢		2.75¢	2.20¢	2.46¢	
Cold-rolled[4]	2.80¢	2.90¢		2.80¢			2.80¢	(Worcester—3.00¢)					2.90¢	3.16¢	
Cooperage stock	2.20¢	2.20¢			2.20¢		2.20¢							2.56¢	
Commodity cold-rolled	2.95¢	3.05¢		2.95¢			2.95¢	(Worcester—3.35¢)					3.05¢	3.31¢	
TINPLATE															
Standard cokes, base box	$5.00	$5.00	$5.00		$5.10			$5.10	$5.10					$5.35[11]	$5.28[11]
Electro, box 0.25 lb	$4.35	$4.35	$4.35					$4.45							
Electro, box 0.50 lb	$4.50	$4.50	$4.50					$4.60	$4.60						
Electro, box 0.75 lb	$4.65		$4.65					$4.75	$4.75						
BLACKPLATE															
29 gage[5]	3.05¢	3.05¢	3.05¢					3.15¢	3.15¢			4.05¢[11]			3.32¢
TERNES, MFG.															
Special coated, base box	$4.30	$4.30	$4.30						$4.40						
BARS								(Duluth—2.35¢,							
Carbon steel	2.25¢	2.25¢	2.25¢	2.25¢	2.25¢	2.25¢	2.25	Provo, Utah 2.95¢)			2.60¢	2.90¢	2.35¢	2.59¢	2.57¢
Rail steel[6]	2.25¢	2.25¢	2.25¢	2.25¢	2.25¢	2.25¢					2.60¢	2.90¢			
Reinforcing (billet)[7]	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢			2.50¢	2.55¢	2.25¢	2.39¢	
Reinforcing (rail)[7]	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢	2.15¢				2.50¢	2.55¢	2.25¢		2.47¢
Cold-finished[8]	2.75¢	2.75¢	2.75¢	2.75¢		2.75¢			(Detroit—2.80¢)		(Toledo—2.90¢)			3.09¢	3.07¢
Alloy, hot-rolled	2.70¢	2.70¢				2.70¢	2.70	(Bethlehem, Massillon, Canton—2.70¢)					2.80¢		
Alloy, cold-drawn	3.35¢	3.35¢	3.35¢	3.35¢		3.35¢							3.45¢		
PLATES								(Coatesville and Claymont—2.25¢, Provo, Utah 2.95¢)							
Carbon steel[13]	2.25¢	2.25¢	2.25¢	2.25¢	2.25¢		2.25¢	2.25¢			2.60¢	2.80¢	2.47¢	2.44¢	2.30¢
Floor plates	3.50¢	3.50¢									3.85¢	4.15¢		3.86¢	3.82¢
Alloy	3.50¢	3.50¢			(Coatesville—3.50¢)						3.95¢	4.15¢		3.70¢	3.59¢
SHAPES															
Structural	2.10¢	2.10¢	2.10¢		2.10¢	2.10¢	(Bethlehem—2.10¢)				2.45¢	2.75¢		2.27¢	2.215¢
SPRING STEEL, C-R															
0.26 to 0.50 carbon	2.80¢			2.80¢			(Worcester—3.00¢)								
0.51 to 0.75 carbon	4.30¢			4.30¢			(Worcester—4.50¢)								
0.76 to 1.00 carbon	6.15¢			6.15¢			(Worcester—6.35¢)								
1.01 to 1.25 carbon	8.35¢			8.35¢			(Worcester—8.55¢)								
WIRE[9]															
Bright[12]	2.75¢	2.75¢		2.75¢	2.75¢		(Worcester—2.85¢)		(Duluth—2.80¢)			3.25¢			3.07¢
Galvanized	Add proper size extra and galvanizing extra to Bright Wire base														
Spring (high carbon)	3.35¢	3.35¢		3.35¢			(Worcester—3.45¢)					3.85¢			3.67¢
PILING															
Steel sheet	2.40¢	2.40¢				2.40¢						2.95¢			2.72¢

CORROSION AND HEAT RESISTANT STEELS

in cents per pound, f.o.b. basing point

BASING POINT	Chromium Nickel		Straight Chromium			
	No. 304	No. 302	No. 410	No. 430	No. 442	No. 446
Ingot, P'gh, Chi, Canton, Balt, Reading, Ft. Wayne, Phila.	Subject to negotiation			Subject to negotiation		
Blooms, P'gh, Chi, Canton, Phila, Reading, Ft. Wayne, Balt	21.25	20.40	15.725	16.15	19.125	23.375
Slabs, P'gh, Chi, Canton, Balt, Phila, Reading	21.25	20.40	15.725	16.15	19.125	23.375
Billets, P'gh, Chi, Canton, Newark, N. J., Watervliet, Syracuse, Balt	Subject to negotiation			Subject to negotiation		
Billets, forging, P'gh, Chi, Canton, Dunkirk, Balt, Phila, Reading, Watervliet, Syracuse, Newark, N. J., Ft. Wayne, Titusville	21.25	20.40	15.725	16.15	19.125	23.375
Bars, h-r, P'gh, Chi, Canton, Dunkirk, Watervliet, Newark, N. J., Syracuse, Balt, Phila, Reading, Ft. Wayne, Titusville	25.00	24.00	18.50	19.00	22.50	27.50
Bars, c-f, P'gh, Chi, Cleve, Canton, Dunkirk, Newark, N. J., Syracuse, Balt, Phila, Reading, Ft. Wayne, Watervliet	25.00	24.00	18.50	19.00	22.50	27.50
Plates, P'gh, Middletown, Canton	29.00	27.00	21.50	22.00	26.50	30.50
Shapes, structural, P'gh, Chi	25.00	24.00	18.50	19.00	22.50	27.50
Sheets, P'gh, Chi, Middletown, Canton, Balt	36.00	34.00	26.50	29.00	32.50	36.50
Strip, h-r, P'gh, Chi, Reading, Canton, Youngstown	23.50	21.50	17.00	17.50	24.00	35.00
Strip, c-r, P'gh, Cleve, Newark, N. J., Reading, Canton, Youngstown	30.00	28.00	22.00	22.50	32.00	52.00
Wire, c-d, Cleve, Dunkirk, Syracuse, Balt, Reading, Canton, P'gh, Newark, N. J., Phila	25.00	24.00	18.50	19.00	22.50	27.50
Wire flat, c-r, Cleve, Balt, Reading, Dunkirk, Canton	30.00	28.00	22.00	22.50	32.00	52.00
Rod, h-r, Newark, N. J., Syracuse	25.00	24.00	18.50	19.00	22.50	27.50
Tubing, seamless, P'gh, Chi, Canton, (4 in. to 6 in.)	66.63	66.63	.....	63.30	.....	.....

SHELL STEEL

	per gross ton
3 in. to 12 in.	$52.00
12 in. to 18 in.	54.00
18 in. and over	56.00

Basic openhearth shell steel, f.o.b. Pittsburgh, Chicago, Buffalo, Gary, Cleveland, Youngstown and Birmingham.

Prices delivered Detroit are $2.00 higher; East Michigan, $3 higher.

Price Exceptions: Follansbee Steel Corp. permitted to sell at $13.00 per gross ton, f.o.b. Toronto, Ohio, above base price of $52.00.

Note: The above base prices apply on lots of 1000 tons of a size and section to which are to be added extras for chemical requirements, cutting, or quantity.

ELECTRICAL SHEETS

Base, all grades f.o.b. Pittsburgh

	per lb
Field grade	3.30¢
Armature	3.65¢
Electrical	4.15¢
Motor	5.05¢
Dynamo	5.75¢
Transformer 72	6.25¢
Transformer 65	7.25¢
Transformer 58	7.75¢
Transformer 52	8.55¢

F.o.b. Chicago and Gary, field grade through motor; f.o.b. Granite City, add 10¢ per 100 lb on field grade to and including dynamo. Pacific ports add 75¢ per 100 lb on all grades.

RAILS, TRACK SUPPLIES

(F.o.b. mill)

Standard rails, heavier than 60 lb	
No. 1 O.H., gross ton	$43.00
Angle splice bars, 100 lb	2.70
(F.o.b. basing points)	*per gross ton*
Light rails (from billets)	$45.00
Light rails (from rail steel)	44.00
	base per lb
Cut spikes	3.25¢
Screw spikes	5.40¢
Tie plate, steel	2.30¢
Tie plates, Pacific Coast	2.45¢
Track bolts	4.75¢
Track bolts, heat treated, to railroads	5.00¢
Track bolts, jobbers discount	63-5

Basing points, light rails, Pittsburgh, Chicago, Birmingham; cut spikes and tie plates—Pittsburgh, Chicago, Portsmouth, Ohio, Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., Birmingham and Pacific Coast ports; tie plates alone—Steelton, Pa., Buffalo. Cut spikes alone—Youngstown, Lebanon, Pa., Richmond, Oregon and Washington ports, add 25¢.

TOOL STEEL

(F.o.b. Pittsburgh, Bethlehem, Syracuse, Dunkirk)

(*Also Canton, O.)	*base per lb*
High speed	67¢
Straight molybdenum	54¢
Tungsten-molybdenum	57½¢
High-carbon-chromium*	43¢
Oil hardening*	24¢
Special carbon*	22¢
Extra carbon*	18¢
Regular carbon*	14¢

Warehouse prices east of Mississippi are 2¢ per lb higher; west of Mississippi 3¢ higher.

CLAD STEEL

Base prices, cents per pound

	Plate	*Sheet*
Stainless-clad		
No. 304, 20 pct, f.o.b. Pittsburgh, Washington, Pa.	18.00*	19.00
Nickel-clad		
10 pct, f.o.b. Coatesville, Pa.	18.00	....
Inconel-clad		
10 pct, f.o.b. Coatesville	25.00	....
Monel-clad		
10 pct, f.o.b. Coatesville	24.00	....
Aluminized steel		
Hot dip, 20 gage, f.o.b. Pittsburgh	....	9.00

*Includes annealing and pickling.

WIRE PRODUCTS

To the trade, f.o.b. Pittsburgh, Chicago, Cleveland, Birmingham, Duluth

	Basing Points Named	*Pacific Coast Basing Points†*
	base per keg	
Standard wire nails	$2.90	$3.40
Coated nails	2.90	3.40
Cut nails, carloads	3.85	....
	base per 100 lb	
Annealed fence wire	$3.20	$3.70
Annealed galv. fence wire	3.55	4.05
	base column	
Woven wire fence*	67	85
Fence posts, carloads	69	86
Single loop bale ties	66	91
Galvanized barbed wire**	72	82
Twisted barbless wire	72	....

*15½ gage and heavier. **On 80-rod spools in carload quantities.

†Prices subject to switching or transportation charges.

ROOFING TERNEPLATE

(F.o.b. Pittsburgh, 112 sheets)

	20x14 in.	20x28 in.
8-lb coating I.C.	$6.00	$12.00
15-lb coating I.C.	7.00	14.00
20-lb coating I.C.	7.50	15.00

ALLOY EXTRAS

Alloy Steel	Basic Openhearth		Electric Furnace	
	Bars and Bar-strip	Billets, Blooms and Slabs	Bars and Bar-strip	Billets, Blooms, and Slabs
NE 8600	0.65¢	$13.00	$1.15	$23.00
NE 8700	0.70	14.00	1.20	24.00
NE 9400	0.75	15.00	1.25	25.00
NE 9700	0.65	13.00	1.15	23.00
NE 9800	1.30	26.00	1.80	36.00
NE 9900	1.20	24.00	1.55	31.00

The extras shown are in addition to the base price of $2.70 per 100 lb on finished products and $54 per gross ton on semifinished steel, major basing points, as shown in table, opposite page, and are in cents per pound when applicable to bars and bar-strip and in dollars per gross ton when applicable to billets, blooms and slabs. When acid openhearth is specified and acceptable, add to basic openhearth alloy differential 0.25¢ per lb for bars and bar-strip and $5 per gross ton for billets, blooms and slabs.

WELDED PIPE AND TUBING

Base discounts, f.o.b. Pittsburgh district and Lorain, Ohio, mills

(F.o.b. Pittsburgh only on wrought pipe)
base price—$200.00 per net ton

	Black	Galv.
Steel (buttweld)		
½-in.	63½	51
¾-in	66½	55
1-in. to 3-in.	68½	57½
Wrought Iron (buttweld)		
½-in.	24	3½
¾-in.	30	10
1-in. and 1¼-in.	34	16
1½-in.	38	18½
2-in.	37½	18
Steel (lapweld)		
2-in.	61	49½
2½-in. and 3-in.	64	52½
3½-in. to 6-in.	66	54½
Wrought Iron (lapweld)		
2-in.	30½	12
2½-in. to 3½-in.	31½	14½
4-in.	33½	18
4½- in. to 8-in.	32½	17
Steel (butt, extra strong, plain ends)		
⅛-in.	61½	50½
¾-in.	65½	54½
1-in. to 3-in.	67	57
Wrought Iron (same as above)		
⅛-in.	25	6
¾-in.	31	12
1-in. to 2-in.	38	19½
Steel (lap, extra strong, plain ends)		
2-in.	59	48½
2½-in. and 3-in.	63	52½
3½-in. to 6-in.	66½	56
Wrought Iron (same as above)		
2-in.	33½	15½
2½-in. to 4-in.	39	22½
4½-in. to 6-in.	37½	21

On buttweld and lapweld steel pipe jobbers are granted a discount of 5 pct. On l.c.l. shipments prices are determined by adding 25 pct and 30 pct and the carload freight rate to the base card.

F.o.b. Gary prices are two points lower discount or $4 a ton higher than Pittsburgh or Lorain on lapweld and one point lower discount, or $2 a ton higher on all buttweld.

BOILER TUBES

Seamless steel and lapweld commercial boiler tubes and locomotive tubes, minimum wall. Net base prices per 100 ft f.o.b. Pittsburgh, Chicago, in carload lots

	Seamless Cold-Drawn	Seamless Hot-Rolled	Lap-weld, Hot-Rolled
2 in. O.D. 13 B.W.G.	15.03	13.04	12.38
2½ in. O.D. 12 B.W.G.	20.21	17.54	16.58
3 in. O.D. 12 B.W.G.	22.48	19.50	18.35
3½ in. O.D. 11 B.W.G.	28.37	24.62	23.15
4 in. O.D. 10 B.W.G.	35.20	30.54	28.66

(Extras for less carload quantities)

40,000 lb or ft and over.....Base
30,000 lb or ft to 39,999 lb or ft.... 5 pct
20,000 lb or ft to 29,999 lb or ft....10 pct
10,000 lb or ft to 19,999 lb or ft....20 pct
5,000 lb or ft to 9,999 lb or ft....30 pct
2,000 lb or ft or 4,999 lb or ft....45 pct
Under 2,000 lb or ft.....65 pct

CAST IRON WATER PIPE

Per Net Ton

6-in. and larger, del'd Chicago.....$54.80
6-in. and larger, del'd New York... 52.20
6-in. and larger, Birmingham..... 46.00
6-in. and larger, f.o.b. cars, San Francisco or Los Angeles..... 69.40
6-in. and larger f.o.b. cars, Seattle. 71.20

Class "A" and gas pipe, $3 extra; 4-in. pipe is $3 a ton above 6-in. Prices shown are for lots of less than 200 tons. For 200 tons or over, 6-in. and larger are $45 at Birmingham and $53.80 delivered Chicago, $59.40 at San Francisco and Los Angeles, and $70.20 at Seattle. Delivered prices do not reflect 3 pct tax on freight rates.

BOLTS, NUTS, RIVETS, SET SCREWS

Bolts and Nuts

(F.o.b. Pittsburgh, Cleveland, Birmingham or Chicago)

Machine and Carriage Bolts

Base discount less case lots

Percent Off List

½ in. & smaller x 6 in. & shorter....65½
9/16 & ⅝ in. x 6 in. & shorter.....63½
¾ to 1 in. x 6 in. & shorter.....61
1⅛ in. and larger, all lengths.....59
All diameters over 6 in. long.....59
Lag, all sizes.....62
Plow bolts.....65

Nuts, Cold Punched or Hot Pressed

(Hexagon or Square)

½ in. and smaller.....62
9/16 to 1 in. inclusive.....59
1⅛ to 1½ in. inclusive.....57
1⅝ in. and larger.....56

On above bolts and nuts, excepting plow bolts, additional allowance of 10 pct for full container quantities. There is an additional 5 pct allowance for carload shipments.

Semifin. Hexagon Nuts	U.S.S.	S.A.E.
Base discount less keg lots		
7/16 in. and smaller	..	64
½ in. and smaller	62	..
½ in. through 1 in.	..	60
9/16 in. through 1 in.	59	..
1⅛ in. through 1½ in.	57	58
1⅝ in. and larger	56	..

In full keg lots, 10 pct additional discount.

Stove Bolts

Consumer

Packages, nuts loose.....71 and 10
In packages.....71
In bulk.....80

On stove bolts freight allowed up to 65¢ per 100 lb based on Cleveland, Chicago, New York on lots of 200 lb or over.

Large Rivets

(½ in. and larger)

Base per 100 Lb

F.o.b. Pittsburgh, Cleveland, Chicago, Birmingham..... $3.75

Small Rivets

(7/16 in. and smaller)

Percent Off List

F.o.b. Pittsburgh, Cleveland, Chicago, Birmingham.....65 and 5

Cap and Set Screws	*Consumer Percent Off List*
Upset full fin, hexagon head cap screws, coarse or fine thread, up to and incl. 1 in. x 6 in.	64
Upset set screws, cup and oval points	71
Milled studs	46
Flat head cap screws, listed sizes	36
Fillister head cap, listed sizes	51

Freight allowed up to 65¢ per 100 lb based on Cleveland, Chicago or New York on lots of 200 lb or over.

FLUORSPAR

Maximum price f.o.b. consumer's plant, $30 per short ton plus either (1) rail freight from producer to consumer, or (2) rail freight from Rosiclare, Ill., to consumer, whichever is lower.

Exception

When the WPB Steel Div. certifies in writing the consumers need for one of the higher grades of metallurgical fluorspar specified in the table below the price shall be taken from the table plus items (1 and 2) from paragraph above.

Effective CaF_2 Content:	*Base price per short ton*
70% or more	$33.00
65% but less than 70%	32.00
60% but less than 65%	31.00
Less than 60%	30.00

METAL POWDERS

Prices are based on current market prices of ingots plus a fixed figure. F.o.b. shipping point, cents per lb, ton lots.

Copper, electrolytic, 150 and 200 mesh.....21½¢ to 23½¢
Copper, reduced, 150 and 200 mesh.....20½¢ to 25½¢
Iron, commercial, 100 and 200 mesh 96 + % Fe.....12½¢ to 15¢
Iron, crushed, 200 mesh and finer, 90 + % Fe carload lots..... 4¢
Iron, hydrogen reduced, 300 mesh and finer, 98½ + % Fe, drum lots..... 63¢
Iron, electrolytic, unannealed, 300 mesh and coarser, 99 + % Fe 30 to 33¢
Iron, electrolytic, annealed minus 100 mesh, 99 + % Fe..... 42¢
Iron carbonyl, 300 mesh and finer, 98-99.8 + % Fe..... 90¢
Aluminum, 100 and 200 mesh..... *25¢
Antimony, 100 mesh..... 30¢
Cadmium, 100 mesh..... $1.40
Chromium, 100 mesh and finer ... $1.25
Lead, 100, 200 & 300 mesh....11½ to 15¢
Manganese..... 65¢
Nickel, 150 mesh..... 51½¢
Solder powder, 100 mesh..8½¢ plus metal
Tin, 100 mesh..... 58¾¢
Tungsten metal powder, 98%-99%, any quantity, per lb..... $2.60
Molybdenum powder, 99%, in 200-lb kegs, f.o.b. York, Pa., per lb... $2.60
Under 100 lb..... $3.00

*Freight allowed east of Mississippi.

COKE

	Net Ton
Furnace, beehive (f.o.b. oven)	
Connellsville, Pa.	$7.50*
Foundry, beehive (f.o.b. oven)	
Fayette Co., W. Va.	8.10
Connellsville, Pa.	9.00
Foundry, Byproduct	
Chicago, del'd	13.75
Chicago, f.o.b.	13.00
New England, del'd.	14.65
Kearny, N. J., f.o.b.	13.05
Philadelphia, del'd	13.28
Buffalo, del'd	13.40
Portsmouth, Ohio, f.o.b.	11.50
Painesville, Ohio, f.o.b.	12.15
Erie, del'd	13.15
Cleveland, del'd	13.20
Cincinnati, del'd	13.25
St. Louis, del'd	13.75†
Birmingham, del'd	10.90

*Hand drawn ovens using trucked coal permitted to charge $8.60 per ton plus transportation charges.

†Except producers situated in states other than Missouri, Alabama or Tennessee, sellers may charge a maximum delivered price of $14.25 in the St. Louis, Mo., and East St. Louis, Ill., switching districts.

REFRACTORIES

(F.o.b. Works)

Fire Clay Brick	*Per 1000*
Super-Duty brick, St. Louis	$68.50
First quality, Pa., Md., Ky., Mo., Ill.	54.40
First quality, New Jersey	59.35
Sec. quality, Pa., Md., Ky., Mo., Ill.	49.35
Sec. quality, New Jersey	51.95
No. 1 Ohio	45.60
Ground fire clay, net ton	8.05
Silica Brick	
Pennsylvania and Birmingham	$54.40
Chicago District	62.45
Silica cement, net ton (Eastern)	9.55
Chrome Brick	*Per Net Ton*
Standard chemically bonded, Balt., Plymouth Meeting, Chester	$54.00
Magnesite Brick	
Standard, Balt. and Chester	$76.00
Chemically bonded, Baltimore	65.00
Grain Magnesite	
Domestic, f.o.b. Balt. and Chester in sacks (carloads)	$43.48
Domestic, f.o.b. Chewelah, Wash. in bulk	22.00
in sacks	26.00

LAKE SUPERIOR ORES

(51.50% *Fe, Natural Content, Delivered Lower Lake Ports)**

Per Gross Ton

Old range, bessemer, 51.50..... $4.95
Old range, non-bessemer, 51.50.... 4.80
Mesaba, bessemer, 51.50..... 4.70
Mesaba, non-bessemer, 51.50..... 4.55
High phosphorus, 51.50..... 4.35

**Adjustments are made to indicate prices based on variance of Fe content of ores as analyzed on a dry basis by independent laboratories.

WAREHOUSE PRICES

Delivered metropolitan areas per 100 lb. These are zoned warehouse prices in conformance with latest zoning amendment to OPA Price Schedule 49.

Cities	SHEETS			STRIP		Plates ¼ in. and heavier	Structural Shapes	BARS		ALLOY BARS			
	Hot Rolled (10 gage)	Cold Rolled	Galvanized (24 gage)	Hot Rolled	Cold Rolled			Hot Rolled	Cold Finished	Hot Rolled, NE 8617-20	Hot Rolled, NE 9442-45 Ann.	Cold Drawn, NE 8617-20	Cold Drawn, NE 9442-45 Ann.
**Philadelphia	$3.518	$4.872[8]	$4.868[a]	$3.922	$4.772	$3.605	$3.666	$3.822	$4.172	$5.818	$6.866	$7.072	$8.172
New York	3.59	4.613	5.210	3.974[6]	4.772	3.768	3.758	3.853	4.203	5.858	6.908	7.103	8.203
Boston	3.744	4.744[9]	5.324[9]	4.106	4.715	3.912	3.912	4.044	4.244	6.012	7.062	7.194	8.394
Baltimore	3.394	4.852	4.994	3.902	4.752	3.594	3.759	3.802	4.152	....	....	....	....
Norfolk	3.771	4.965	5.471	4.165	4.865	3.971	4.002	4.065	4.265	....	....	....	....
Chicago	3.25	4.20	5.331	3.60	4.65[17]	3.55	3.55	3.50	3.85	5.60	6.65	6.65	7.75
Milwaukee	3.387	4.337	5.372	3.737	4.787[17]	3.687	3.687	3.637	3.987	5.837	6.887	6.887	8.137
Cleveland	3.35	4.40	4.977	3.60	4.45[17]	3 40	3.588	3.35	3.85	5.806	6.856	6.65	7.75
Buffalo	3.35	4.40	4.85	3.819	4.669	3.63	3 40	3.35	3.85	5.60	6.65	6.65	7.75
Detroit	3.45	4.50	5.10	3.70	4.659[17]	3 609	3.661	3.45	3.90	5.93	6.98	6.959	8.059
Cincinnati	3.425	4.475	4.925[5]	3.675	4.711	3.661	3.691	3.611	4.111	5.95	7.00	7.011	8.261
St Louis	3.397	4.347	5.231	3.747	4.931[17]	3.697	3.697	3.647	4.131	5.981	7.031	7.031	8.131
Pittsburgh	3.35	4.40	4.85	3.60	4.45	3.40	3.40	3 35	3.85	5.60	6.65	6.65	7.75
St. Paul	3.50	4.46	5.357	3.86	5.102[17]	3.81[13]	3.81[13]	3.76[13]	3.461	5.94	5.99	7.361	8.461
Omaha	3.865	5.443	5.615	4.143	....	4.093	4 093	4.043	4.543	....	....	....	....
Indianapolis	3.52	4.568	5.018	3.768	4.741	3.63	3.63	3.58	4.08	5.93	6.98	6.98	8.23
Birmingham	3.45	....	4.85	3.70	....	3.55	3.55	3.50	4.53	....	....	....	....
Memphis	3.965	4.78	5 365	4.215	....	4.065	4.065	4.015	4.33	....	....	....	....
New Orleans	4.058*	5.079	5.458	4.308	....	4.158	4.158*	4.108*	4.729	....	....	....	....
Houston	3.763	5.573	6.413[1]	4.313	....	4.25	4 25	3.75	6.473[3]	7.223	8.323	8.323	9.373
Los Angeles	5.00	7.20	6.20	4.95	5.613[15]	4.95	4.65	4.40	5.683	8.204	9.404	9.304	10.454
San Francisco	4.55[14]	7.30[4]	6.45	4.50[14]	7.333[17]	4.65[14]	4.35[14]	4.15[14]	5.433	8.304	9.404	9.404	10.454
Seattle	4.65[12]	7.05[4]	6.05	4.25[12]	....	4.75[12]	4.45[12]	4.35[12]	5.783	....	9.404	....	....
Portland	4 65[11]	6.60[4]	5.85	4.75[11]	....	4.75[11]	4.45[11]	4.45[11]	5.633	8.304	9.404	8.304	9.404
Salt Lake City	4.530[17]	....	6.27[13]	5.53[17]	....	4.98[17]	4.98[17]	4.88[17]	6.00	....	....	....	....

BASE QUANTITIES

Standard unless otherwise keyed on prices.

HOT-ROLLED: Sheets, strip, plates, shapes and bars, 400 to 1999 lb.

COLD-FINISHED: Sheets, 400 to 1499 lb; strip, extras on all quantities; bars, 1500 lb base.

GALVANIZED: 450 to 1499 lb.

NE ALLOY BARS: 1000 to 39,999 lb.

EXCEPTIONS: (1) 150 to 499 lb. (2) 150 to 1499 lb. (3) 400 to 1499 lb. (4) 450 to 1499 lb. (5) 500 to 1499 lb. (6) 0 to 199 lb. (7) 400 to 1499 lb. (8) 1000 to 1999 lb. (9) 450 to 3749 lb. (10) 400 to 3999 lb. (11) 300 to 4999 lb. (12) 300 to 10,000 lb. (13) 400 to 14,999 lb. (14) 400 lb and over. (15) 1000 lb and over. (16) 1500 lb and over. (17) 2000 lb and over. (18) 3500 lb and over.

(a) Philadelphia: Galvanized sheet, 25 or more bundles.

Extra for size, quality, etc., apply on above quotations.

*Add 0.271¢ for sizes not rolled in Birmingham.

**City of Philadelphia only. Applicable freight rates must be added to basing point prices to obtain delivered price to other localities in metropolitan area.

PIG IRON PRICES

Maximum per gross ton, established by OPA Oct. 22, 1945. Prices do not reflect 3 pct tax on freight.

BASING POINT PRICES						DELIVERED PRICES (BASE GRADES)							
Basing Point	Basic	No. 2 Foundry	Malleable	Bessemer	Low Phos.	Consuming Point	Basing Point	Freight Rate	Basic	No. 2 Foundry	Malleable	Bessemer	Low Phos.
Bethlehem	$26.25	$26.75	$27.25	$27.75	.....	Boston	Everett	$ .50	$26.75	$27.25	$27.75	$28.25	.....
Birdsboro	26.25	26.75	27.25	27.75	$31.25	Boston	Birdsboro-Steelton	4.02	.....	.....	.....	.....	$35.27
Birmingham	20.75	22.13	.....	26.75	.....	Brooklyn	Bethlehem	2.50	28.75	29.25	29.75	30.25	.....
Buffalo	.4.75	25.75	26.25	26.75	31.25	Brooklyn	Birdsboro	2.92	.....	.....	.....	.....	34.17
Chicago	25.25	25.75	25.75	26.25	.....	Canton	Clev.,Ygstn,Sharpsvil.	1.39	26.64	27.14	27.14	27.64	.....
Cleveland	25.25	25.75	25.75	26.25	.....	Canton	Buffalo	3.19	.....	.....	.....	.....	34.44
Detroit	25.25	25.75	25.75	26.25	.....	Cincinnati	Birmingham	4.06	24.81	26.19	.....	.....	.....
Duluth	25.75	26.25	26.25	26.75	.....	Cincinnati	Hamilton	1.11	.....	.....	26.86	.....	.....
Erie	25.25	25.75	26.25	26.75	.....	Cincinnati	Buffalo	4.40	.....	.....	.....	.....	35.65
Everett	26.25	26.75	27.25	27.75	.....	Jersey City	Bethlehem	1.53	27.78	28.28	28.78	29.28	.....
Granite City	25.25	25.75	25.75	26.25	.....	Jersey City	Birdsboro	1.94	.....	.....	.....	.....	35.19
Hamilton	25.25	25.75	25.75	.....	.....	Los Angeles	Provo	4.95	28.20	28.70	.....	.....	.....
Neville Island	25.25	25.75	25.75	26.25	.....	Los Angeles	Buffalo	15.41	.....	.....	.....	.....	46.66
Provo	23.25	23.75	.....	.....	.....	Mansfield	Cleveland & Toledo	1.94	27.19	27.69	27.69	28.19	.....
Sharpsville [1]	25.25	25.75	25.75	26.25	.....	Mansfield	Buffalo	3.36	.....	.....	.....	.....	34.61
Sparrows Point	26.25	26.75	.....	.....	.....	Philadelphia	Swedeland	.84	27.09	27.59	28.09	28.59	.....
Steelton	26.25	.....	.....	.....	31.25	Philadelphia	Birdsboro	1.24	.....	.....	.....	.....	32.49
Swedeland	26.25	26.75	27.25	27.75	.....	San Francisco	Provo	4.95	28.20	28.70	.....	.....	.....
Toledo	25.25	25.75	25.75	26.25	.....	San Francisco	Buffalo	15.41	.....	.....	.....	.....	46.66
Youngstown	25.25	25.75	25.75	26.25	.....	Seattle	Provo	4.95	28.20	28.70	.....	.....	.....
						Seattle	Buffalo	15.41	.....	.....	.....	.....	46.66
						St. Louis	Granite City	.50	25.75	26.25	26.25	26.75	.....
						St. Louis	Buffalo	7.07	.....	.....	.....	.....	38.32

(1) Struthers Iron & Steel Co., Struthers, Ohio, may charge 50¢ per ton in excess of basing point prices for No. 2 foundry, basic, bessemer and malleable.

Charcoal pig iron base prices for Lyles, Tenn., and Lake Superior furnaces, $33.00 and $34.00, respectively. Newberry Brand of Lake Superior charcoal iron $39.00 per g.t., f.o.b. furnace, by order L 39 to RPS 10. Apr. 11, 1945, retroactive to Mar. 7, 1945. Delivered to Chicago, $42.34. High phosphorus iron sells at Lyles, Tenn., at $28.50.

Basing point prices are subject to switching charges; silicon differentials (not to exceed 50¢ per ton for each 0.25 pct silicon content in excess of base grade which is 1.75 to 2.25 pct); phosphorus differentials, a reduction of 38¢ per ton for phosphorous content of 0.70 pct and over; manganese differentials, a charge not to exceed 50¢ per ton for each 0.50 pct manganese content in excess of 1.00 pct. Effective Mar. 3, 1943, $2 per ton extra may be charged for 0.5 to 0.75 pct nickel content and $1 per ton extra for each additional 0.25 pct nickel.

Silvery iron and bessemer ferrosilicon up to and including 14.00 pct silicon covered by RPS 10 as amended Feb. 14, 1945. Silvery iron, silicon 6.00 to 6.50 pct, C/L per g.t., f.o.b. Jackson, Ohio—$31.25; f.o.b. Buffalo—$32.50. Add $1.00 per ton for each additional 0.50 pct Si. Add 50¢ per ton for each 0.50 pct Mn over 1.00 pct. Add $1.00 per ton for prices of comparable analysis.

Ferromanganese

78-82% Mn, maximum contract base price per gross ton, lump size, f.o.b. car at Baltimore, Philadelphia, New York, Birmingham, Rockdale, Rockwood, Tenn.

Carload lots (bulk)	$135.00
Less ton lots (packed)	148.50
F.o.b. Pittsburgh	139.50

$1.70 for each 1% above 82% Mn; penalty, $1.70 for each 1% below 78%.

Ferromanganese Briquets

Contract prices per pound of briquet, f.o.b. shipping point, freight allowed to destination. Approx. 66% contained Mn. Add 0.25¢ for spot sales.

	Eastern	Central	Western
Carload, bulk	6.05¢	6.30¢	6.60¢
Ton lots	6.65¢	7.55¢	8.55¢
Less ton lots	6.80¢	7.80¢	8.80¢

Manganese Metal

Contract basis lump size, per pound of metal, f.o.b. shipping point with freight allowed. Spot sales add 2¢ per lb.

96-98% Mn, .2% max. C, 1% max. Si, 2% max. Fe.

Carload, bulk	30¢
L.c.l. lots	32¢

Electrolytic Manganese

F.o.b. Knoxville, Tenn., freight allowed east of Mississippi, cents per pound.

Carloads	34¢
Ton lots	36¢
Less ton lots	38¢

Spiegeleisen

Maximum base contract prices per gross ton, lump, f.o.b. Palmerton, Pa.

	16-19% Mn 3% max. Si	19-21% Mn 3% max. Si
Carloads	$35.00	$36.00
Less ton	47.50	48.50
F.o.b. Pittsburgh, Chicago	40.00	

Low-Carbon Ferromanganese

Contract prices per pound of manganese contained, lump size, f.o.b. shipping point, freight allowed to destination, eastern zone. Add 0.25¢ for spot sales.

	Carloads, Ton	Less
0.06% C, 0.06% P, 90% Mn	23.00¢	23.40¢ 23.65¢
0.10% max. C, 1% or 2% max. Si	23.00¢	23.40¢ 23.65¢
0.15% max. C, 1% or 2% max. Si	22.00¢	22.40¢ 22.65¢
0.30% max. C, 1% or 2% max. Si	21.00¢	21.40¢ 21.65¢
0.50% max. C, 1% or 2% max. Si	20.00¢	20.40¢ 20.65¢
0.75% max. C, 7.00% max. Si	16.00¢	16.40¢ 16.65¢

Electric Ferrosilicon

OPA maximum base price cents per pound contained Si, lump size in carloads, f.o.b. shipping point with freight allowed.

	Eastern	Central	Western
50% Si	6.65¢	7.10¢	7.25¢
75% Si	8.05¢	8.20¢	8.75¢
80-90% Si	8.90¢	9.05¢	9.55¢
90-95% Si	11.05¢	11.20¢	11.65¢

Silvery Iron

Si 14.01 to 14.50%, $45.50 per G. T. f.o.b. Jackson, Ohio; $48.75 f.o.b. Keokuk, Iowa; $46.75 f.o.b. Niagara Falls. Add $1.00 per ton for each additional 0.50% Si up to and including 18%. Add $1.00 per ton for low impurities, not to exceed: P—0.05%, S—0.04%, C—1.00%. Covered by MPR 405.

Silicon Metal

OPA maximum base price per pound of contained Si, lump size, f.o.b. shipping point with freight allowed to destination, for l.c.l. above 2000 lb, packed. Add 0.25¢ for spot sales.

	Eastern	Central	Western
96% Si, 2% Fe	13.10¢	13.55¢	16.50¢
97% Si, 1% Fe	13.45¢	13.90¢	16.80¢

Ferrosilicon Briquets

OPA maximum base price per pound of briquet, bulk, f.o.b. shipping point with freight allowed to destination. Approximately 40% Si. Add 25¢ for spot sales.

	Eastern	Central	Western
Carload, bulk	3.35¢	3.50¢	3.65¢
2000 lb-carload	3.80¢	4.20¢	4.25¢

Silicomanganese

Contract basis lump size, per pound of metal, f.o.b. shipping point with freight allowed. Add 25¢ for spot sales. 65-70% Mn, 17-20% Si, 1.5% max. C.

Carload, bulk	6.05¢
2000 lb to carload	6.70¢
Briquet, contract basis, carlots, bulk freight allowed, per lb	5.80¢
2000 lb to carload	6.30¢
Less ton lots	6.55¢

Ferrochrome

(65-72% *Cr*, 2% *max. Si*)

OPA maximum base contract prices per pound of contained Cr, lump size in carload lots, f.o.b. shipping point, freight allowed to destination. Add 0.25¢ per lb contained Cr for spot sales.

	Eastern	Central	Western
0.06% C	23.00¢	23.40¢	24.00¢
0.10% C	22.50¢	22.90¢	23.50¢
0.15% C	22.00¢	22.40¢	23.00¢
0.20% C	21.50¢	21.90¢	22.50¢
0.50% C	21.00¢	21.40¢	22.00¢
1.00% C	20.50¢	20.90¢	21.50¢
2.00% C	19.50¢	19.90¢	21.00¢
66-71% Cr, 4-10% C	13.00¢	13.40¢	14.00¢
62-66% Cr, 5-7% C	13.50¢	13.90¢	14.50¢

High-Nitrogen Ferrochrome

Low-carbon type: 67-72% Cr, 0.75% N. Add 2¢ per lb to regular low-carbon ferrochrome price schedule. Add 2¢ for each additional 0.25% N. High-carbon type: 66-71% Cr, 4-5% C, 0.75% N. Add 5¢ per lb to regular high-carbon ferrochrome price schedule.

Ferrochrome Briquets

Contract prices per pound of briquet, f.o.b. shipping point, freight allowed to destination. Approx. 60% contained chromium. Add 0.25¢ for spot sales.

	Eastern	Central	Western
Carload, bulk	8.25¢	8.55¢	8.95¢
Ton lots	8.75¢	9.25¢	10.75¢
Less ton lots	9.00¢	9.50¢	11.00¢

Calcium—Manganese—Silicon

Contract prices per pound of alloy, lump size, f.o.b. shipping point, freight allowed to destination.

16-20% Ca, 14-18% Mn, 53-59% Si. Add 0.25¢ for spot sales.

	Eastern	Central	Western
Carloads	15.50¢	16.00¢	18.05¢
Ton lots	16.50¢	17.35¢	19.10¢
Less ton lots	17.00¢	17.35¢	19.60¢

Calcium Metal

Eastern zone contract prices per pound of metal, f.o.b. shipping point, freight allowed to destination. Add 5¢ for spot sales. Add 0.9¢ for central zone; 0.49¢ for western zone.

	Cast	Turnings	Distilled
Ton lots	$1.80	$2.30	$5.00
Less ton lots	2.30	2.80	5.75

Chromium—Copper

Contract price per pound of alloy, f.o.b. Niagara Falls, freight allowed east of the Mississippi. 9-11% Cr, 88-90% Cu, 1.00% max. Fe, 0.50% max. Si. Add 2¢ for spot sales.

Shot or ingot	45¢

Ferroboron

Contract prices per pound of alloy, f.o.b. shipping point, freight allowed to destination. Add 5¢ for spot sales. 17.50% min. B, 1.50% max. Si, 0.50% max. Al, 0.50% Max. C.

	Eastern	Central	Western
Ton lots	$1.20	$1.2075	$1.229
Less ton lots	1.30	1.3075	1.329

Manganese—Boron

Contract prices per pound of alloy, f.o.b. shipping point, freight charges allowed. Add 5¢ for spot sales.

75.00% Mn, 15-20% B, 5% max. Fe, 1.50% max. Si, 3.00% max. C.

	Eastern	Central	Western
Ton lots	$1.89	$1.903	$1.935
Less ton lots	2.01	2.023	2.055

Nickel—Boron

Spot and contract prices per pound of alloy, f.o.b. shipping point, freight allowed to destination.

15-18% B, 1.00% max. Al, 1.50% max. Si, 0.50% max. C, 3.00% max. Fe, balance Ni.

	Eastern	Central	Western
11,200 lb or more	$1.90	$1.9125	$1.9445
Ton lots	2.00	2.09125	2.0445
Less ton lots	2.10	2.1125	2.1445

Other Ferroalloys

Ferrotungsten, standard grade lump or ¼X down, packed f.o.b. plant at Niagara Falls, New York, Washington, Pa., York, Pa., per pound contained tungsten, 10,000 lb or more	$1.90
Ferrovanadium, 35-55%, contract basis, f.o.b. plant, usual freight allowances, per pound contained V.	
Openhearth	$2.70
Crucible	$2.80
Primos	$2.90
Cobalt, 97% min., keg packed, contract basis, f.o.b. producers plant, usual freight allowances, per pound of cobalt metal	$1.50
Vanadium pentoxide, 88-92% V_2O_5 technical grade, contract basis, any quantity, per pound contained V_2O_5. Spot sales add 5¢ per lb contained V_2O_5	$1.10
Silcaz No. 3, contract basis, f.o.b. plant with usual freight allowances, per pound of alloy.	
carload lots	25¢
2000 lb to carload	26¢
Silvaz No. 3, contract basis, f.o.b. plant with freight allowances, per pound of alloy.	
carload lots	58¢
2000 lb to carload	59¢
Grainal, f.o.b. Bridgeville, Pa., freight allowed 50 lb and over, max. based on rate to St. Louis	
No. 1	87.5¢
No. 6	60¢
No. 79	45¢
Bortram, f.o.b. Niagara Falls	
Ton lots, per lb	45¢
Less ton lots, per lb	50¢
Ferrocolumbium, 50-60%, contract basis, f.o.b. plant with freight allowances, per pound contained Cb.	
2000-lb lots	$2.25
Under 2000-lb lots	$2.30
Ferrotitanium, 40-45%, 0.10%C. max. f.o.b. Niagara Falls, N. Y., ton lots, per pound contained Ti	$1.23
Less ton lots	$1.25
Ferrotitanium, 20-25%, 0.10%C. max., ton lots, per pound contained titanium	$1.35
Less ton lots	$1.40
High-carbon ferrotitanium, 15-20%, 6-8% carbon, contract basis, f.o.b. Niagara Falls, N. Y. freight allowed east of Mississippi, north of Baltimore and St. Louis, per carload	$142.50
Ferrophosphorus, 18% electric or blast furnaces, f.o.b. Anniston, Ala., carlots, with $3 unitage freight equalled with Rockdale, Tenn., per gross ton	$58.50
Ferrophosphorus, Electrolytic 23-26%, carlots, f.o.b. Monsanto (Siglo), Tenn., $3 unitage freight equalized with Nashville, per gross ton	$75.00
Ferromolybdenum, 55-75%, f.o.b. Langeloth, Washington, Pa., any quantity, per pound contained Mo	95¢
Calcium molybdate, 40-45%, f.o.b. Langeloth and Washington, Pa., any quantity, per pound contained Mo	80¢
Molybdenum oxide briquets, 48-52% Mo f.o.b. Langeloth, Pa., per pound contained Mo	80¢
Molybdenum oxide, in cans, f.o.b. Langeloth and Washington, Pa., per pound contained Mo	80¢
Zirconium, 35-40%, contract basis, f.o.b. producer's plant with freight allowances, per pound of alloy. Add ¼¢ for spot sales	
Carload lots	14¢
Zirconium, 12-15%, contract basis, lump f.o.b. plant usual freight allowances, per pound of alloy	
Carload, bulk	4.60¢
Alsifer (approx. 20% Al, 40% Si and 40% Fe), contract basis, f.o.b. Niagara Falls, carload, bulk	5.75¢
Ton lots	7.25¢
Simanal (approx. 20% Si, 20% Mn, 20% Al), contract basis, f.o.b. Philo, Ohio, with freight not to exceed St. Louis rate allowed, per pound.	
Car lots	8.00¢
Ton lots	8.75¢
Less ton lots	9.25¢

Hinckley Succeeded By Rose as Director Of Contract Settlement

Washington

• • • **H. Chapman Rose** has been nominated by President Truman to be Director of Contract Settlement, succeeding Robert H. Hinckley, who has resigned, effective Feb. 1 to return to private business as vice-president and director of the American Broadcasting Co., with headquarters in New York. Mr. Rose, now deputy director of the Office of Contract Settlement, has been with the office since its organization in 1944 and previously served as secretary to the Joint Contract Termination Board under John M. Hancock.

In his letter of resignation, Mr. Hinckley, who was appointed Director of Contract Settlement on July 28, 1944, told President Truman that what he undertook to do he felt he had completed and his retirement at this time would not result in detriment to the job which brought him back to the government. Mr. Hinckley has spent the last 10 or 12 yr in government service. He was formerly Assistant Secretary of Commerce for Air and chairman and member of the Civil Aeronautics Authority. Before his appointment as Director of Contract Settlement, Mr. Hinckley was vice-president of Sperry Corp. In accepting his resignation, the President warmly commended Mr. Hinckley for his services.

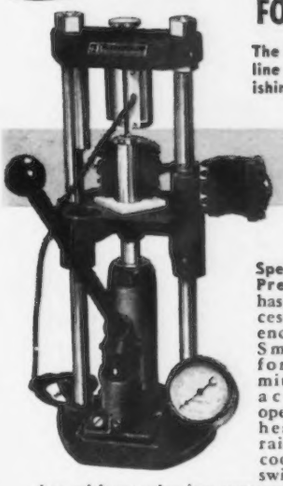
Summarizing the work of the Office of Contract Settlement in his letter of resignation, Mr. Hinckley said that of the 303,000 contracts which have been terminated since the war program began, only about 53,000 remained unsettled at the end of December. Almost 70 pct of the number of contracts still open at VJ-Day or terminated since then has been disposed of, it was pointed out.

"The dollar volume of the canceled part of the still unsettled contracts is large (about $33 billion out of $64 billion since the beginning of war production), which is natural, because the big cases take longest to settle," Mr. Hinckley said. "However, a great deal of the

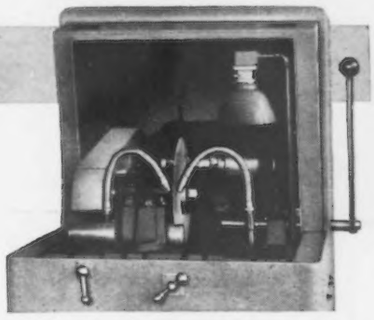
Buehler

SPECIMEN PREPARATION EQUIPMENT AND SUPPLIES FOR THE METALLURGICAL LABORATORY

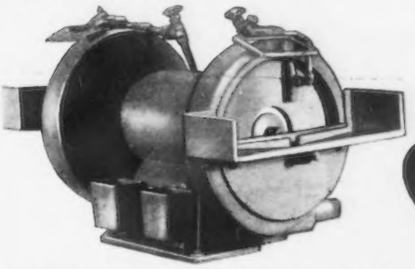
The items illustrated are selected from the complete Buehler line of equipment, tools and accessories for molding and finishing specimen mounts.



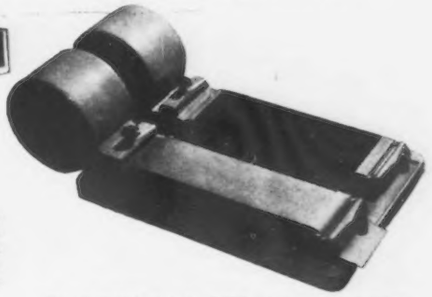
Specimen Mount Press No. 1315 has complete accessibility, no enclosed parts. Smooth performance permits speed and accuracy in operation. Solid heater can be raised and the cooling blocks swing into position without releasing pressure on the mold. This rapid cooling permits production of transoptic mounts in a few minutes. Shipping weight, 100 lbs.



Abrasive Cut-off Machine, Model No. 1000, is a solidly built, heavy duty piece of equipment free from sideplay or vibration with capacity for cutting specimen sections up to 3-1/2". Cutting is done on the front of the wheel and is controlled by a convenient outside lever. The driving motor is a totally enclosed ball bearing, 3 hp. with a separate motor driving the self-contained cooling system. Overall dimensions of cabinet 31" x 47" x 64". Shipping weight, 1400 lbs.



Wet Power Grinder No. 1210, powered with a 3/4 hp. totally enclosed ball bearing motor has two 12" water cooled wheels fitted with closed-in guards and non-shatterable shields. Suitable for coarse and medium grinding. Shipping weight, 310 lbs.



Hand Grinder No. 1410 is a most conveniently arranged two stage grinder. The grinding surfaces are 4-1/2" x 12-1/4" each with heavy 7/16" thick plate glass back. A reserve roll of 150 feet of emery paper is contained in drums for quick renewal of grinding surface. Base has gutter drains for surplus liquid in wet grinding operations. Shipping weight, 95 lbs.

Standard Polisher No. 1500. A complete unit with direct mounted 1/4 hp. radial thrust ball bearing motor. The 8" polishing disc is attached to a tapered arbor on the motor shaft by means of a stout sleeve. This sturdy construction and unusually smooth vibrationless operation helps to prevent pitting and amorphous film in polishing. The removable splash ring forms a convenient hand rest that aids the operator in precision work. A handy control lever on the mounted switch gives selective speeds of 575 and 1150 r.p.m. Shipping weight, 100 lbs.

Low Speed Polisher No. 1505-2, is particularly adapted to final stage polishing and for non-ferrous metal samples. The 8" disc is attached to a countershaft by a tapered sleeve with a long span between bearings, a construction feature that assures smooth operation. The selective speeds of 150 and 250 r.p.m. make this polisher perfectly adapted to the wax lap or lead lap polishing technique. Shipping weight, 105 lbs.

Either the standard or low speed polishers can be furnished in a single unit table model polisher No. 1516. A three unit table model No. 1540 is also available for maximum convenience in three stage polishing.

In the complete line of Buehler accessories and supplies for the metallurgical laboratory are found: Abrasive paper sheets, discs, and rolls in every grade • polishing solutions • polishing cloths • cut-off wheels and molding powders. Buehler service includes everything needed for preparing precision specimens from metallurgical samples, available from one reliable source.

Buehler Ltd.
A PARTNERSHIP

METALLURGICAL APPARATUS
165 West Wacker Drive, Chicago 1, Illinois

necessary work has been done on these cases; and in the light of past experience, they will be settled for a relatively small fraction of the dollar value canceled (10 pct to 15 pct). Considering the amount of advance and partial payments and government loans outstanding against these contracts, industry's remaining investment in them is surprisingly small. In view of the performance to date, I am confident that, if the 168,000 contracts pending unsettled at VJ-Day or terminated between then and the end of the year, much less than 5 pct will still be pending on June 30, 1946.

"This result will have been achieved only by the devoted and untiring efforts of the thousands of people in the contracting agencies and in industry who have been working at the job, and by the highest degree of cooperation between business and government, which may well serve as a model," Mr. Hinckley said.

Commerce Dept. Plans Prefabricated Survey

Washington

• • • **Approximately 150 firms** are now making or planning to make prefabricated houses, ready-cut structures, or components, according to the Construction Div., Dept. of Commerce. Because of the importance of these types of construction in relieving the housing shortage, the Construction Div. said that it will undertake a detailed study of the industry in the near future.

The announcement said that American firms now manufacturing prefabricated houses are planning to go into production at a capacity for turning out about 150,000 units a yr.

It was pointed out that so many home prefabricators were until recently engaged in other production related to war and do not now have adequate inventories, production of prefabricated houses will be slow in starting. However, the Division estimated that well over 100,000 units could be built in 1946 if a sufficient flow of materials could be arranged.

The Division said that prices of prefabricated houses run in general from $2,000 to $6,000, exclusive of the site, with higher prices for the larger and more elaborate types.

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1 They have higher fatigue and impact values, resulting in longer wear and less replacement cost.

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4 They meet severe conditions of wear — lasting several times as long as ordinary bronzes.

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If the equipment you buy has bronze parts that must show exceptional resistance to wear, fatigue, impact, or corrosion, you get a better buy if the parts are of Ampco *Aluminum* Bronze. Check the features above and see how your equipment gains more strength and durability . . . longer life . . . a record of trouble-free performance — when all matting and wearing surfaces are of durable Ampco *Aluminum* Bronze. Ask for frictional parts of Ampco *Aluminum* Bronze on the equipment you buy. Replace with Ampco when old parts fail — and enjoy a far longer period of uninterrupted service. Write for Bulletin No. 71.

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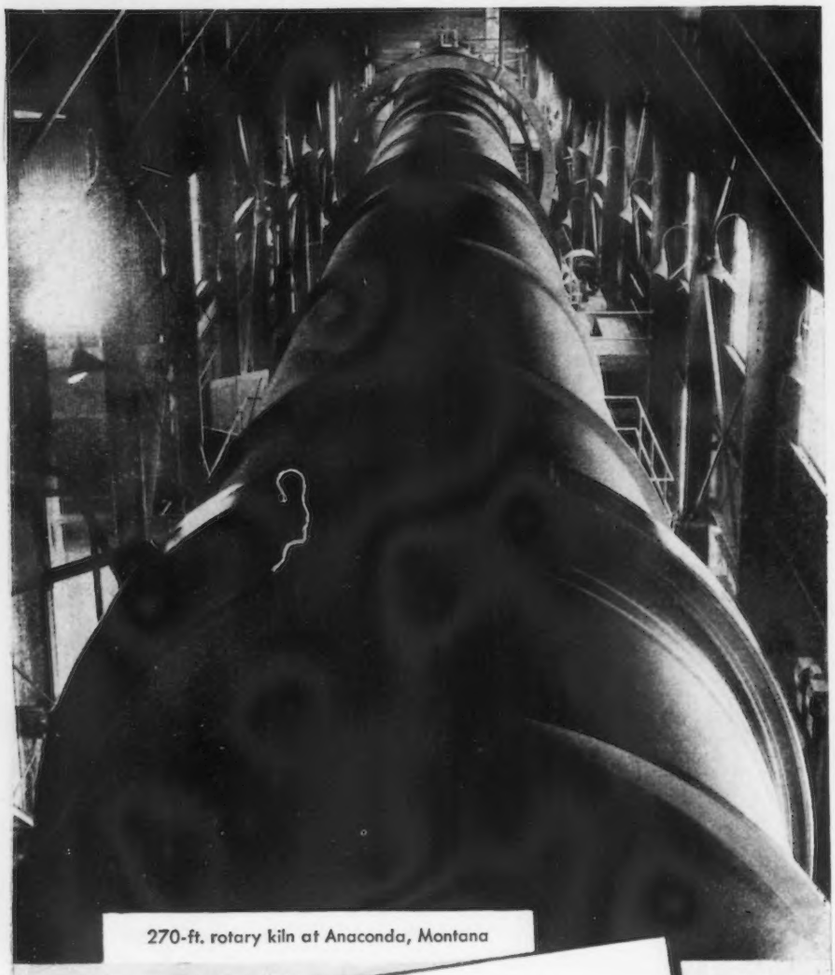

270-ft. rotary kiln at Anaconda, Montana

Anaconda
MANGANESE
NODULES

AVERAGE ANALYSIS

Mn	60%
SiO_2	8%
Al_2O_3	0.76%
Fe	3.1%
P	0.06%

46381

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British Tin Institute Reports on Prospects In Foreign Markets

London

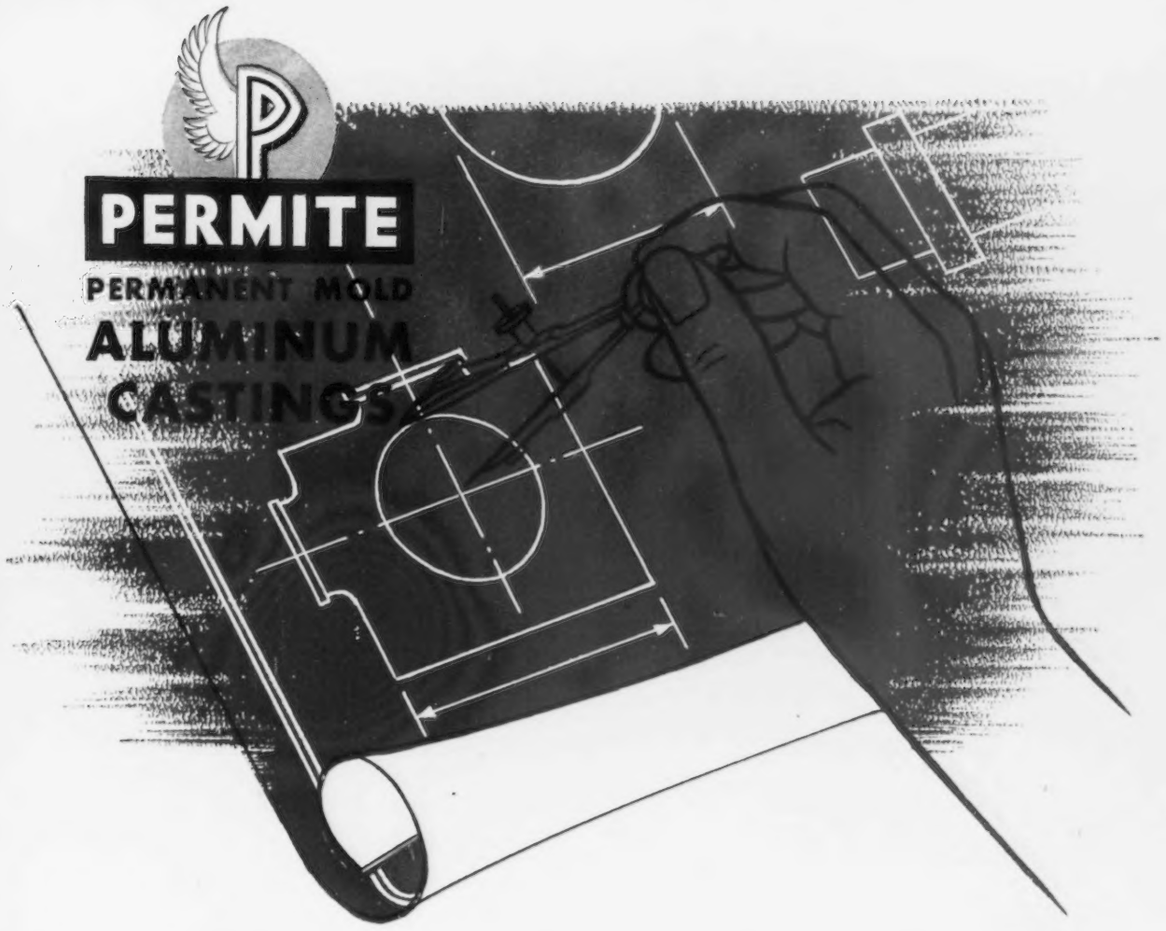
• • • **The present** position and future prospects of the Tin Research Institute have been set out recently in a report issued here by the Institute. With the ending of the war, the Research Institute's world connections have again become active. Requests for technical assistance have been received from Belgium, France, Spain and South America, and the Institute's technical representatives in the United States are again active.

Speculum plate has passed beyond the investigatory stages. In England 16 firms have paid license fees and have put in, or are putting in, the plant. Inquiries are also coming in from most of the European countries. In the U. S. A. the patent situation has occasioned some delay. Inquiries are coming in at the rate of about 25 per month, and the staff is busy in servicing existing installations, and in plating a wide variety of samples from firms who are contemplating the adoption of speculum on their postwar products.

Tin-zinc alloy coatings are reported as having passed the investigatory phase so far as applying them by electrodeposition is' concerned. As, however, these coatings are offered as a finish for resisting the corrosion of steel parts, there is said to be a long vista of comparative performance trials to be completed in each of the several industries in which they may be used. In one particular industry this second stage has been attained. After some months of work, including trials by certain British Government departments, tin-zinc has been accepted as a satisfactory finish for the steel chassis of radio sets, and two small commercial plants have been installed. This is in itself an outlet of useful magnitude, but the Institute considers it to be valuable chiefly as a step to larger applications.

A large potential market is the steel wire used for fencing, netting and flyscreen. Much of this is as present hot galvanized and where electrodeposition of zinc has been adopted, very large units have been installed.

The use of thin tin coatings as a



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Manufacturers want these advantages . . . and more. They seek the alloy proved best for their jobs. They require dimensional accuracy . . . uniformity in structure . . . and every refinement that can be included without functional change. They want closer tolerances and a minimum of machining.

Pioneering Permite engineers and metallurgists — men of 25 years' experience in aluminum techniques and analyses, supported by the Permite modernly equipped foundry — provide these extra essentials. That is why manufacturers of a great variety of products come to Permite with their plans and problems.

Through Permite engineering you, too, can have every advantage aluminum has to offer — in Permite Permanent Mold Aluminum Castings. If you have a parts problem, send blueprint for recommendations of Permite engineers. Of course, there is no obligation to you.

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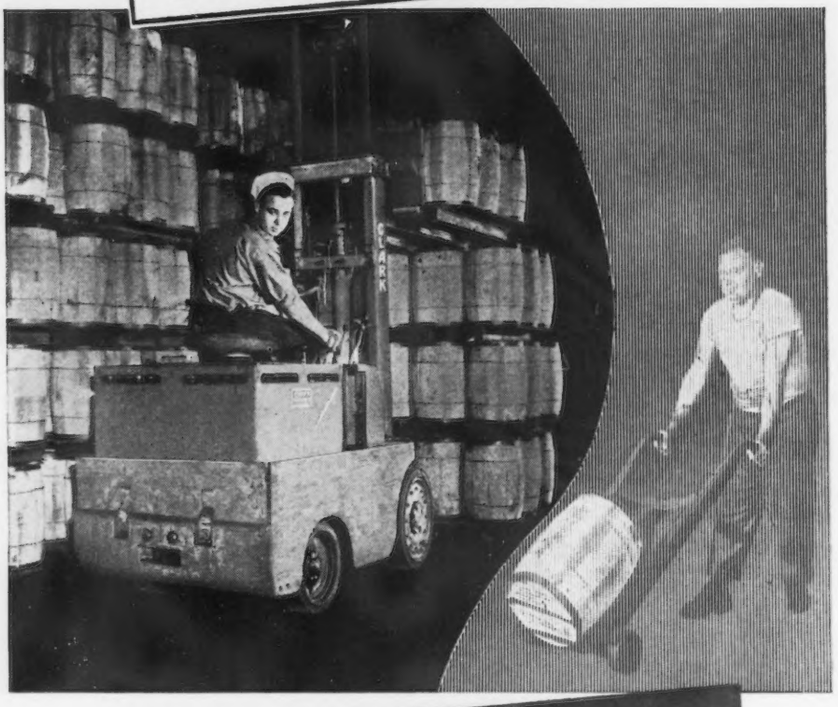
ALUMINUM PERMANENT MOLD, SAND and DIE CASTINGS...HARDENED, GROUND and FORGED STEEL PARTS

This •• or THIS



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preliminary treatment for steel which is subsequently to be painted, is a new development which has been made public by the tin group in the last two months. This is an alternative to "phosphating" or "bonderizing," which is widely used. English inquiries include three large firms interested in products such as motor car bodies, steel office furniture, cookers and refrigerators.

In the commercial production of bronze bars, strip, wire, etc, of increased strength, the laboratory stages are complete as far as casting billets are concerned; and firms in England are making use of these processes for the casting of their own products. But the problem of establishing the commercial marketing of a wide range of sizes of malleable products presents great difficulties. Two processes must be worked out. (1) The continuous casting of long bars or billets. (2) The extrusion of bars, wire rod, etc. As to extrusion, a few trials have been made successfully but very powerful presses are required, and only two or three firms in England have the equipment. These firms are already engaged in some other specialized manufacture and have not yet been able to make it worth their while to interrupt current production to develop the manufacture of this new product.

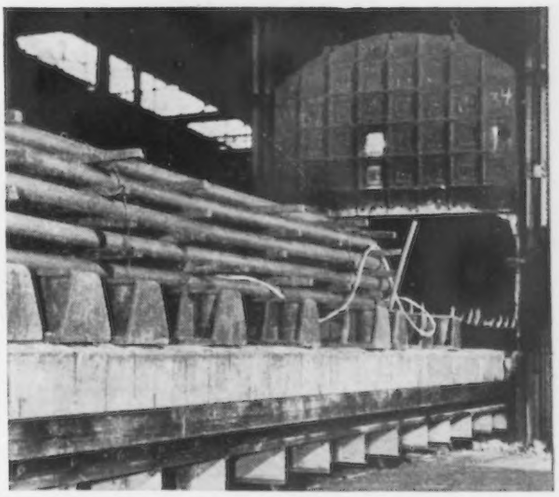
Dresser Earnings Drop

Cleveland

• • • **Net earnings** of Dresser Industries, Inc., and consolidated subsidiaries for the fiscal year ended Oct. 31, 1945, totaled $1,921,628, as compared to $1,575,075 for the year previous, according to the company's annual report to shareholders. Net sales were $80,544,911 by comparison to $54,995,408 for the year ended Oct. 31, 1944. Backlog of business as of Dec. 31, 1945, was $25,500,000.

Fourteen companies, serving primarily the oil and gas industries, are now members of the Dresser group; Payne Furnace Co., Kobe, Inc., Day & Night Mfg. Co., and Security Engineering Co., Inc., all of California, having been added since publication of the last annual report.

Heat Treating and Annealing Capacity Immediately Available



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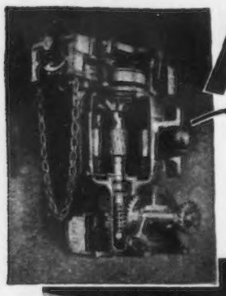
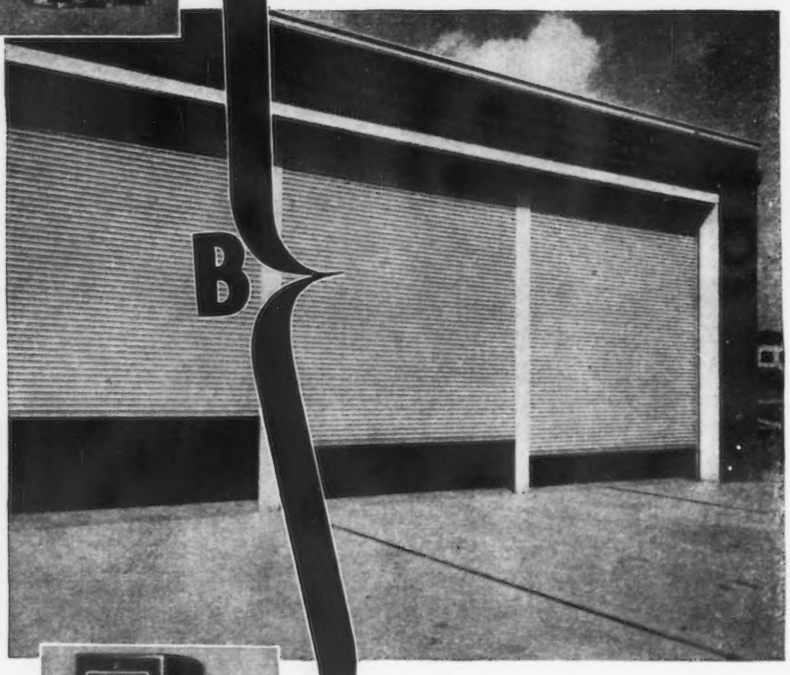


THE ABC's of DOOR EFFICIENCY



A—The Kinnear Motor Operator saves effort, time, and manpower. It goes into action instantly at the touch of a control button—opening, closing, or stopping the door with smooth speed and efficiency. It's a sturdy, integral unit featuring a specially designed torque-output motor, machine-cut gears, and bronze bushings that assure lasting, trouble-free operation.

B—The same bull-dog ruggedness and high operating efficiency are featured in the sturdy, all-steel, interlocking-slat construction of Kinnear Rolling Doors. Coiling into small space above the lintel, Kinnear Doors permit full use of *all* floor and ceiling space around doorways, remaining out of the way and safe from damage when open. These and other basic advantages have made Kinnear a first choice for nearly half a century!

C—Remote Control adds still further convenience and economy by permitting more strategic placing of control buttons, or centralized control stations for any number of doors. It helps eliminate doorway "bottlenecks," and cuts heating and air-conditioning costs by encouraging prompt door closure at all times. Remote control assures maximum advantages from the smooth, easy, time-saving action of Kinnear Motor Operated Rolling Doors.

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Saving Ways in Doorways

G. A. Price Elected Westinghouse President

Pittsburgh

• • • **Gwilym A. Price** has been elected president of Westinghouse Electric Corp., succeeding George H. Bucher, who becomes vice-chairman of the board. As president, Mr. Price will be the chief executive officer of the company. A recent amendment to the Corporation's by-laws made the president the chief executive officer. Mr. Bucher will continue as chairman of the Westinghouse International Co., which handles the export business of the parent company.

G. A. Price

A. W. Robertson, as chairman of the board, has been the chief executive since 1929. He has reached retirement age, but was elected chairman of the board under the new by-laws, and will continue as a member of the Westinghouse organization in a less active capacity.

Mr. Price, at 50, is one of the country's youngest directing heads of a major corporation. He was elected a vice-president of Westinghouse in September, 1943, and has been executive vice-president since May, 1945. He was elected a director of the firm in January, 1945.

His background prior to coming with Westinghouse primarily was in the banking field, being affiliated with Pittsburgh Trust Co., as assistant trust officer from 1920 to 1923. In 1923 he became trust officer of the new Peoples-Pittsburgh Trust Co., later vice-president in charge of trusts, and in 1940 was elected president of the bank.

Navy Dumps Munitions

Washington

• • • **A policy calling** for disposal of obsolete and unserviceable naval ammunition of all types by dumping in deep water has been announced by the Navy Department. Ammunition is considered unserviceable when any doubt exists as to whether or not it can be safely fired or will function properly.

Site Welding of Farm Units Deemed Practical

Pittsburgh

• • • **Many new peacetime** jobs to employ the welders trained for wartime tasks are in sight as a result of research in the construction of steel frame farm buildings by welding together the structural members on the site.

Conducted on a long-time basis by University of Wisconsin through a grant by Carnegie-Illinois Steel Corp., a United States Steel subsidiary, and broadened by engineers of the steel producer itself, the development program proposes low-cost barns, silos, cribs, dairy, poultry and other buildings which may be quickly erected from materials that will be comparatively plentiful in the postwar period.

For several years Carnegie-Illinois has sponsored research at Madison, Wis., seat of the university, (1) to determine the functional requirements of dairy farm buildings, and (2) to make steel a practical and inexpensive building material for farm use. One of the results of the studies is a new site-welded system of construction that makes steel farm buildings competitive with those built of other materials and at the same time opens a broad new avenue of jobs for trained welders.

With the war over, thousands of welders who were urgently needed and trained during the emergency in shipyards, war plants and the armed forces are seeking new industries in which to ply their trade. In addition to those in military service, more than 364,000 welders were at work in war plants at the peak of production—not far below the 427,000 carpenters employed throughout the United States at approximately the same time, a number said by economists to be inadequate to serve the probable building market.

If the Carnegie-Illinois site-welded system of construction is widely adopted for farm building, welders will find opportunities for their skill in the small-building trade. A further incentive to the

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FOR HEAVY
TRAFFIC FLOORS
1
GRIP WITHOUT A SLIP!
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EASY TO MATCH!
So you can Count on these 3
To the inherent characteristics of steel floor plate (such as durability, ability to stand tough traffic, oil, heat, fire and crackproof and no maintenance cost) add, for A. W. Super-Diamond these three distinctive advantages well worth knowing about for safer floors. Notice the shape of the elevations and the pattern? 30% minimum contact area with the shoe. Sloping sides that maintain "sharpness" of contact, resist dirt collection, make for easier cleaning, better draining. And a pattern that matches more easily with less scrap! These are reasons why alert architects, builders, product engineers, and purchasing agents are insisting on AW Super-Diamond Floor Plates.
Write For 16 page Booklet L-27 Giving Helpful Information on Weight Per Square Foot and Maximum Sizes, Alan Wood Steel Company, Conshohocken, Pa.
AW SUPER-DIAMOND
FLOOR PLATES THAT GRIP
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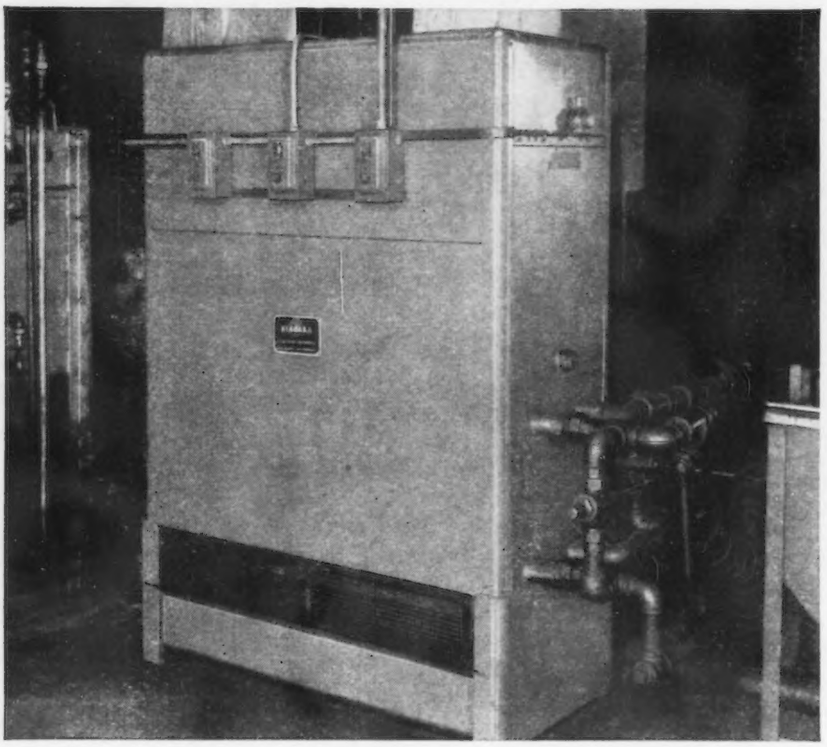
NIAGARA AERO HEAT EXCHANGER

Removes Heat at Rate of Input—gives extra capacity for Increased Production



Heat treat quenching is no longer a haphazard process when you regulate the temperature of quenching baths with the NIAGARA AERO HEAT EXCHANGER. It removes heat at the rate of input, maintaining the exact temperature to produce specified, uniform physical properties. In continuous quenching systems it speeds production.

Fast and accurate cooling is an important safety feature for inflammable baths, keeping the oil from reaching the flash point. Holding the temperature with precision, which includes the prevention of "over-cooling," is made possible by the patented Niagara "Balanced Wet Bulb" Control. And since 95% of the cooling water is saved, the NIAGARA method pays for itself in a short time with direct economies.

For complete description write for Bulletin No. 96.

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development of this type of construction is the ready availability of welding equipment. In addition to purchases by repair shops, many farmers are buying welding sets, and manufacturers are producing them in constantly increasing quantities.

No attempt is being made to limit the use of materials for this field of construction strictly to steel. Where other materials can be employed more economically and to functional advantage, they may be used. In fact, the structures being designed by Carnegie-Illinois combine economically several building materials—lumber, asphalt, asbestos, cement and others—assembled on a basic steel structure, for steel provides maximum strength and rigidity at low cost.

In the construction of many one-story farm buildings having clear spans from 24 to 40 ft, only nine—and possibly as few as five—sizes of steel members, primarily standard angles, channels, light columns and plates, are needed for framework. If a combination of steel and other materials is used, an even smaller number of steel sections may be required.

The small number of steel products required in this type of construction makes it practical for progressive building material dealers, warehouses, builders and welding shops to carry adequate steel stocks to serve the farm trade. The research engineers believe local builders can use steel economically because it will be readily available from local dealers in standard sizes which may be cut to desired length and quickly, easily and permanently welded on the job into a great variety of strong structures.

Through Carnegie-Illinois Steel Corp.'s plan service, pilot plans for many different types of site-welded farm buildings will be made available to building supply dealers, welding shops and local builders, including steel framing for larger farm buildings having clear spans upward from 24 ft. Smaller buildings may be prefabricated more economically of sheet steel or framed of other types of building material.

What Comes FIRST in Heat Treating?

Millions of dollars have been invested in AJAX HULTGREN Salt Bath Furnaces. Already there are over 2000 installations! Why? Because every vital plant is taking advantage of the "firsts" offered by AJAX. Here they are:

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2. An AJAX Furnace provides *uniform* heat at all points . . . regardless of the complexity of the work. Temperature control is assured . . . within 5 deg. F., *at the work*, regardless of bath size!

3. An AJAX Furnace controls atmosphere, because it eliminates it! Work withdrawn from the bath is protected by the "salt film" . . . right to the instant of quenching! This results in avoiding oxidation, scaling, or decarburization—without added expense.

4. An AJAX Furnace does not require skilled labor.

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A complete battery of production type furnaces and the services of a competent metallurgical staff are available for heat treating specimen work. No obligations.

The internal heating principle that eliminated all pot maintenance problems and made it possible to place salt bath furnaces in direct line of production—often completely conveyorized. Only the Ajax furnace possesses the patented electromotive circulation of the bath—the flow that inhibits temperature differences anywhere in the bath.

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ANNEALING—stainless, low and high carbon steels, silver, copper alloys, etc.
BRAZING—ferrous and non-ferrous assemblies
HARDENING HIGH SPEED STEEL TOOLS—tungsten, moly and cobalt types
SOLUTION HEAT TREATMENT—aluminum and beryllium alloys
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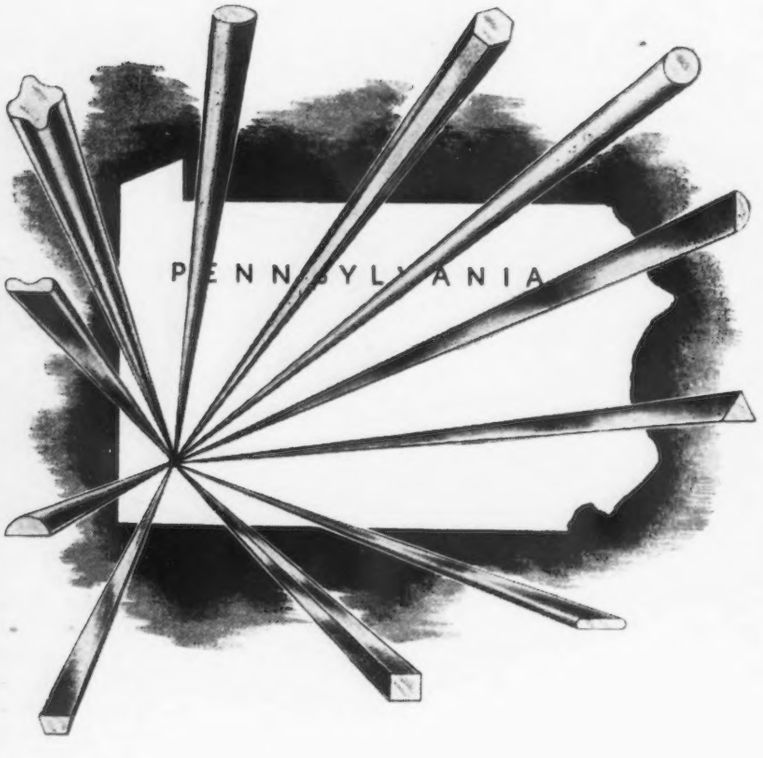
PAGE *Stainless Steel* WIRE



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PAGE STEEL AND WIRE DIVISION
AMERICAN CHAIN & CABLE

Good Enameling Steels Determined by Analysis And Cleaning Methods

New York

• • • **The quality of the** sheet iron or steel which is to be enameled is of the highest importance inasmuch as many of the troubles associated with enameling have been traced to the metal according to a paper by Dr. E. E. Marbaker, Hommel research fellow at the Mellon Institute, published in Ceramic Forum.

In the early days when the function of the metal was not well understood, there was considerable warpage, and the impurities produced such defects as copperheads (penetration of iron oxide through the enamel), blisters from gas inclusions, and fishscaling (also thought to be caused by gas evolution).

Problems involved in the elimination of these defects have been seriously studied by steel companies in their efforts to produce metal having the proper chemical composition and physical qualities to insure both workability and enamelability, and by excellent metallurgical research continuous improvement in the quality of enameling iron has resulted. The problems involved are difficult because the properties of the iron and of the enamel must be carefully coordinated in the face of a considerable difference of opinion in regard to fundamental theory.

The early irons were fairly high in carbon and metalloids, and it has been found that lower carbon and a higher degree of purity are essential. Many steel mills have produced good enameling irons, of which several possess unusually good enameling characteristics. Chemical control has been worked out to the point that poor enameling qualities can usually be detected in the mill.

The fundamental chemical requirements are low carbon, not over 0.1 pct and low metalloid content. The metal should be free from solid and gaseous impurities which might cause blistering and other surface defects. The sheet should not warp, sag, or otherwise be deformed when properly supported at enameling temperatures. It should have good gas and electric welding properties. There should be no lamination, slag in-

closures, or gas pockets. The drawing qualities should be well-adapted to the forming of ware by stamping and spinning. The surface should be especially suitable for enameling.

Enamelers have not standardized any particular surface characteristics from the metallurgical point of view, but they are agreed that the removal of oil, grease, and drawing compounds must be easily accomplished, and that, after pickling, the surface will be such that the pick-up of enamel shall be uniform. As little gas as possible should be evolved in the firing of the enamel.

The type of steel surface and freedom from strains are to a large extent controlled by the rolling procedure and heat treatment in the steel mill. Strains may be introduced during fabrication of ware but those which cannot be eliminated by proper design can be removed or minimized by suitable annealing.

With the advent of thinner enamel coatings the gage of metal used in the industry has gradually been reduced so that, whereas in the earlier practice 18-gage metal was employed, it is now customary to use 20 or 22-gage sheet.

Sheet iron passing through the fabrication operations of an enameling plant—stamping, drawing, spinning, and welding—will of course oxidize to some extent and pick up greater or less quantities of oily substances. Obviously such contaminants must be completely removed before the ware can be successfully enameled.

Three methods for the removal of oil and grease from sheets of ware are in general use: (1) scaling, (2) sandblasting, and (3) chemical cleaning.

In scaling the ware is heated in a muffle furnace at 1200-1300°F until all organic matter has been burned off, an operation which may require from one to three min. or longer depending upon the amount of oil present and the charge placed in the furnace. Care must be taken to prevent overheating which might cause warping. The method is efficient but relatively expensive; it was formerly much more generally used, but today finds its chief application in the treatment of pieces having deep draws, roll edges or flanges in which cases the clean-

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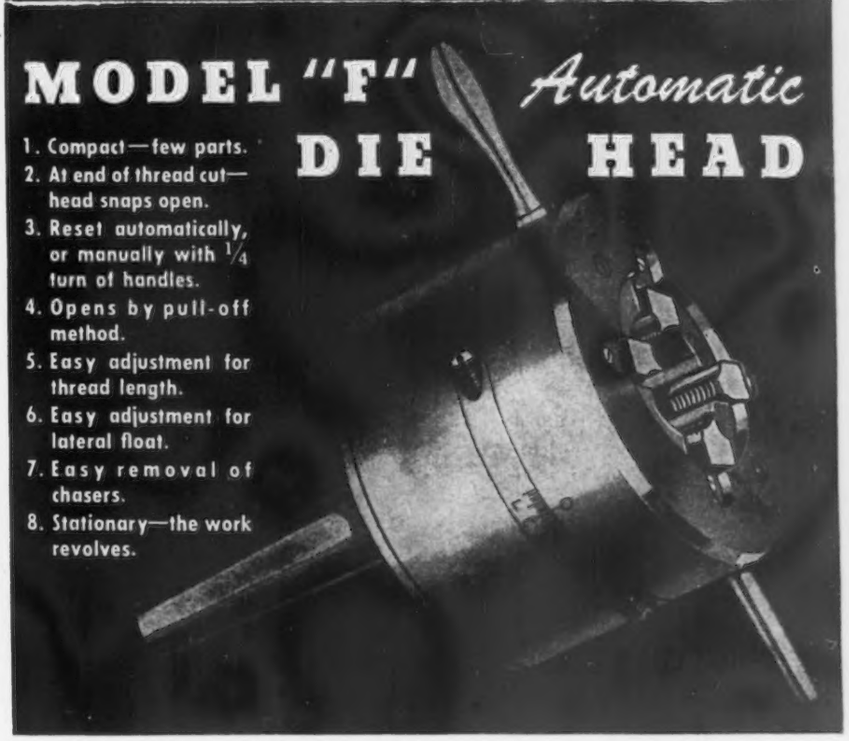

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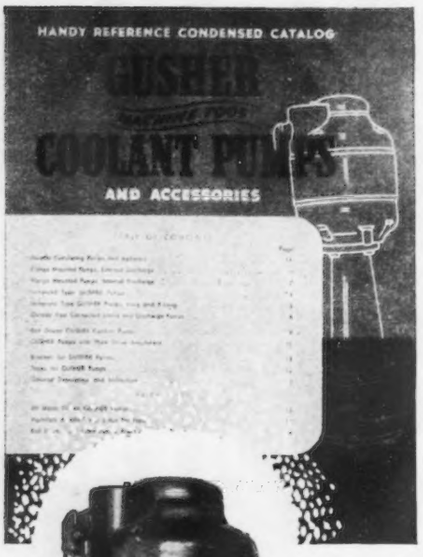

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ing is accompanied by annealing to release the strains and thus improve the enameling qualities of the ware.

Sandblasting is relatively unimportant because it can be used only with the heavier gages of sheet steel—14 gage or heavier. Much care must be exercised in regard to the air pressure lest the sand strike the metal too hard. Unfortunately oil and grease cannot be removed in this way and the ware must first be cleaned by scaling or by chemical treatment. The chief application of sandblasting in sheet steel enameling is to remove enamel in order to reclaim expensive fabricated shapes that have surface defects.

In chemical cleaning organic solvents such as naphtha, gasoline, kerosene, or benzol may be effective in the removal of oil and grease, but are seldom, if ever, used in cleaning ware to be enameled. Such solvents are expensive, the fire hazard is great, and a thin film of solvent remains on the metal to which the water-suspended enamel will not adhere.

The cleaning agents in almost universal use are alkalies in water solution. The compounding of substances of this type has been the subject of considerable research and development as a result of which a number of thoroughly satisfactory cleaners, are available. Basically cleaners contain such alkaline materials as sodium carbonate, sodium hydroxide, borax, sodium phosphate, sodium silicate, and sodium cyanide, the last mentioned representing the most recent development.

Cleaners are dissolved in water to produce concentrations recommended by the makers on the basis of the results of many practical tests. The solution is used at boiling temperature, the higher the better.

The cleaning process is obviously effected by the alkali content of the cleaner which promotes emulsification and saponification of the oils and fats which are usually of animal or vegetable origin. Mineral oil is not saponified, but the presence of soaps aids the emulsification by which its removal is accomplished.

In the pickling operation iron oxide in the form of scale or rust is removed from the ware by treatment with hot (150-160°F) dilute sulfuric acid or cold hydrochloric acid in which the oxide dissolves.

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Photo Courtesy Pantex Pressing Machine, Inc.

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A large chemical company promises to build a million-and-a-half dollar plant for the production of synthetic caffeine. The raw materials will be air and water. *Monsanto Chemical Co.*

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During the war, the principle of mass production was applied to the making of marine chronometers, increasing the output from 400 a year to thousands. *Hamilton Watch Company.*

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One of our leading technical colleges is planning to establish a gas turbine research laboratory which will include a supersonic wind tunnel and special facilities for the study of compressors, combustion devices, jets and other gas turbine elements. *M.I.T.*

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Indication of industry's increasing use of the multiple spindle automatic is the recent announcement of the new five-spindle machine built by Warner & Swasey.

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In a new radio-phonograph set the radio unit can be readily removed and used separately. *Westinghouse.*

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A new mechanical cotton picker is designed to take advantage of the recently developed method of defoliating the plant by means of a chemical spray. *Charles R. Berry, Vicksburg, Miss.*

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An optical company announces the development of a light-polarizing glass. Previous polarizers have been made of natural crystals or plastic film. *American Optical Co.*

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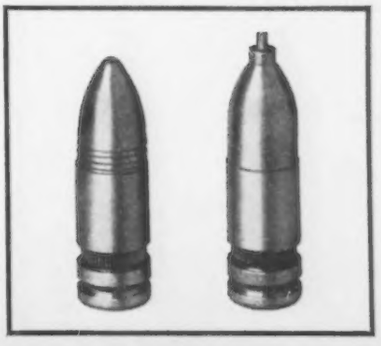

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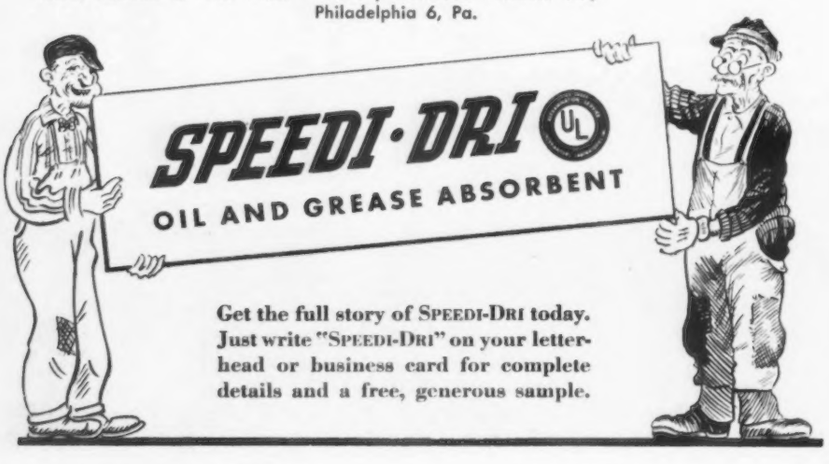
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Sulfuric acid is employed in a concentration of about 6 pct, and hydrochloric acid at about 11 pct. The acid attacks the metal to some extent and the hydrogen thus produced tends to push the scale off the surface. A proper degree of etching is advantageous in that it improves the pick-up of enamel slip. The time of pickling is usually from 10 to 20 min., depending upon the concentration of the acid, the temperature, and the amount of scale to be removed. Care must be taken to avoid too high concentration of acid as well as temperature because of the tendency of iron to absorb the hydrogen generated in the reaction, which in the firing of the enamel will be released and cause blistering. Moreover, a greater depth of etching is produced and the roughened surface tends to pick up more enamel than is desirable and may cause trouble in firing. Obviously the correct concentration of acid should be carefully controlled between known practical limits.

After both the cleaning and the pickling operations have been completed, the ware must be thoroughly rinsed in running warm water to remove adhering alkali or acid whose retention would cause trouble and also to prevent carry-over which would add to the expense of metal preparation. Very recently the use of sodium cyanide in the after-pickling rinse water has been proposed because of the effectiveness of the salt in removing harmful sulfates and chlorides. The cyanide removes smudge and also tends to improve the draining of ground coat.

In order to make doubly sure that no acid is carried along by the metal, the ware is immersed in a hot (150-160°F) dilute (0.3-0.4 pct Na_2O) solution of the neutralizing compound, which may be 90 pct soda ash and 10 pct borax or these salts with sodium phosphate. Neutralizing compounds are also made especially for the purpose and the proper concentrations are established by the manufacturers. The time of the neutralizing operation depends largely upon the conditions present. The concentration of the neutralizer must be under close control. If the solution is too strong, the salts will dry on the ware and cause trouble with the enamel later. If it is too weak, the acid will not be completely neutralized and will lead to de-

fects in firing.

After neutralization the ware is allowed to drain and then is placed in a hot dryer with a good circulation of air in order that water may be eliminated so rapidly that the metal has no chance to rust. Properly prepared metal has a straw or goldenbrown color.

In some plants, and the number of them is growing, a nickel bath is placed in the pickling line following the acid rinse. The bath contains nickel salts and boric acid at a hydrogen ion concentration between 5.6 and 6.4 which must be carefully maintained. The temperature is 160-180°F. The ware is left in the bath from 5 to 15 min during which time the nickel plates out on the iron electrolytically. The nickel flash is efficacious in increasing adherence and preventing fishscaling.

In the recently developed Hommelaya Process, blue ground coats, which contain cobalt and manganese, can be replaced by cobalt-free ground coats. The ware, after being neutralized, is immersed for a short time in an ammoniacal cobalt solution. In drying afterward, water and ammonia are expelled, and the cobalt complex decomposes to form cobalt hydroxide which remains on the surface. In some manner, at present not fully understood, this compound reacts with enamel during firing to produce a highly satisfactory bond with the metal, although the ground coat contains no cobalt whatever.

Enamels are generally applied to the metal in two or more coats, each coat being fired before the next is applied. The first coat is called a ground or grip coat and usually contains a small amount of cobalt and manganese oxides which increase the adherence of the enamel to the metal. This coat fires to a deep blue color. The enamels for the subsequent coats are so formulated that they adhere one to another although they would not by themselves adhere well to the metal. They may have any color whatever. The number of coats required depends upon the opacity or covering power of the enamels used as cover coats. In general white enamels are applied in two coats, but it has been demonstrated in recent refrigerator enameling practice that satisfactory results can be obtained by the application of one heavier cover coat.

YOU DON'T USE A SLEDGE TO DRIVE TACKS

THERE was a time when machine tools had to be heavy to be accurate but modern engineering and manufacturing methods have changed that. Today, the fully equipped shop has its big lathes for big work, and SHELDON S-56 Precision Lathes for small parts. With accuracy that will hold the closest tolerances and the stamina to stand up to continuous high speed operation, these smaller, handier, moderate priced lathes are cutting the cost of and increasing the hourly output of small turned parts.

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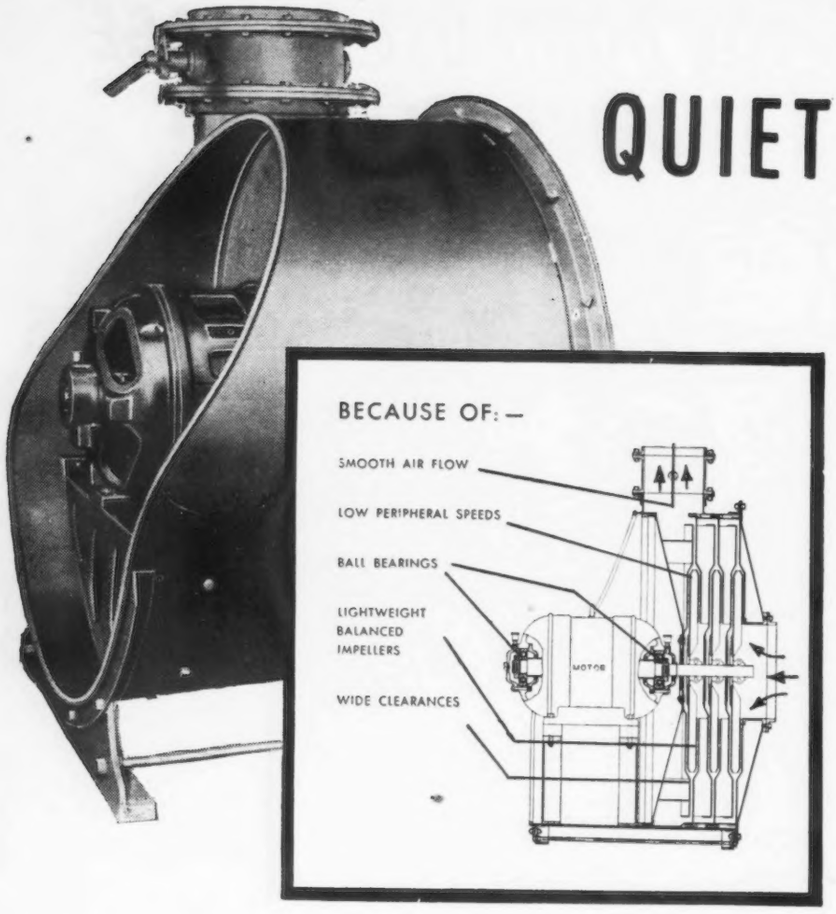

Spencer Turbos deliver large volumes of air with constant pressure regardless of load.

Besides the points indicated above, Spencers are simple as an electric fan, have only two bearings, and a one-piece, all-metal casing, reinforced by ribbed end sections. A bridge-like casting supports the motor and rotating elements and evenly distributes the weight.

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TURBO-COMPRESSORS

Enamel may be applied to the metal by dipping the ware in the slip and allowing the excess to drain off, or by spraying the slip on the metal by means of a gun operated with compressed air. Sheet iron ground coats are generally applied by dipping or slushing; in the first method the enamel drains by itself, and in the second the ware is rotated and shaken at the same time. Cover coats may be applied by dipping if the ware is to be covered on both sides; but if only one side is to be coated, the enamel is usually sprayed. Hollow ware must of necessity be dipped, and a high degree of skill is required to produce an evenly distributed coating of the specified thickness. Ware to be dipped may be held in the hands directly or with tongs. In the latter procedure the tongs have to be designed for the particular shape that is to be dipped. In either case the piece is dipped in the enamel and then rotated and shaken simultaneously to eliminate excess slip.

Another feature of the Hommelaya Process is the application by spraying of two or more coats of enamel to the metal without intermediate firing. Pieces so enameled are fired only once and thereby a reduction in cost of the enameling process is effected. In carrying out this method of application, the metal is cobalt-dipped and dried, as already explained, and then a white ground coat is sprayed on the metal to the desired thickness. Immediately and without actual drying the proper weight of the first cover coat is sprayed over the ground coat.

After an enamel slip has been milled and aged it is seldom in exactly the correct condition for application to the metal in so far as the specific gravity, mobility and yield value are concerned, and, therefore, it is necessary to make certain adjustments at the tank in the case of dipping or in a storage container if the enamel is to be sprayed. This adjustment, called "setting-up" involves the addition of the correct amounts of water and certain chemicals, as the result of which the enamel slip will flow easily on the surface of the ware, drain evenly, and set to form a layer of the desired thickness. The chemicals used for this purpose are known scientifically as flocculants, but in ordinary practice they are called "setting-up agents."

Reveals Development Of New Applications For Ceramic Coatings

Washington

• • • **Developed by the** National Bureau of Standards primarily to protect the exhaust systems of military internal combustion engines, ceramic coatings that may stay put under extreme heat promise to have important peacetime applications, according to the Dept. of Commerce.

The investigation was undertaken when shortages of certain metals used in the manufacture of stainless steel made it necessary to find a substitute for this alloy in the exhaust stacks of aircraft engines. It was pointed out that if a ceramic coating could be developed that would adequately protect exhaust systems in which this special steel was not used, the problem would be solved.

Exhaustion experiments demonstrated that the addition of certain quantities of calcined aluminum oxide and a slight modification of conventional practice produced an enamel coating that would protect conventional steel exhaust stacks from corrosion.

While the new coating was not widely used on aircaft engine exhaust stacks for the reason that military aviation had top priority on available stainless steel, the results, it was stated, were wholly satisfactory wherever employed.

Another use of great military importance was in the coating of the exhaust systems of Army Ducks for which no priority on stainless steel had been provided. In the Pacific Theater especially it was found that the exhaust systems of the ducks corroded quickly and seriously. When exhaust pipes were given the new ceramic coating inside and outside, the department said, the corrosion problem was solved.

To insure best results the new ceramic enamel must be applied in thin coats—not more than 0.002 to 0.003 in. on the exhaust stacks of aircraft engines and ducks. It has a dull finish such as found in conventional porcelain enamels and is applied at a temperature of 1600°F, only a little higher than that ordinarily used.

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As it is difficult to point out which is the most important leg of a three-legged stool, so it is hard to say which of these factors is the most vital . . . we know from experience that *all* are necessary. Proof of wire rope quality is in performance . . . why not find out for yourself just what "HERCULES" can do on your own job? Many who have made this test are now regular users.

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NEWS OF INDUSTRY

A section of exhaust stack that had been subjected to repeated applications of great heat at a given point showed no break whatever in the new coating. Even when the metal itself bulged slightly at the point where the heat was applied, forming a sort of blister, the coating was not affected. Heat appled fewer times but in the same manner to a stack coated with porcelain enamel caused breaks in the coating at the point of application.

Dr. Edward U. Condon, Director of the Bureau of Standards, is addressing letters to all manufacturers to whom disclosure of the new enamel process has been made confidentially advising them that the veil of secrecy is now lifted. Dr. Condon also is informing manufacturers that the bureau has pending an application for a patent. If the patent is granted the new process will be available to all who wish to use it, without payment of fee, under the usual revocable, nontransferable and nonexclusivze license. He likewise will tell the manufacturers that the Dept. of Commerce "desires to have its contribution to the development of these coatings used as widely as possible for the greatest benefit to industry and to the public."

The investigation was conducted under the immediate supervision of W. N. Harrison, Chief, Enameled Metals Section, Bureau of Standards. Asked whether the new coatings are going into commercial use, Mr. Harrison said:

"A beginning has been made with manufacturers showing an active interest. It must be remembered, of course, that the new coatings are of the utility and industrial type for application where protection against high temperatures is necessary. Automobile manufacturers are among those indicating an active interest in the use of these coatings on the exhaust systems of cars and trucks.

"Two manufacturers have called at the bureau to inquire about the possible use of the new coatings on heat exchangers for marine and other turbine engines.

"Several stove manufacturers are showing keen interest in applications of the new coatings to

certain parts of their products, including the inner liners of oil space heaters. Another application under consideration is the coating of burners on gas ranges, the supports on which the pots rest and other points where high-temperature resistance is important.

"Kitchen utensils are something else again. It is quite possible, however, that a small admixture of the active ingredient of the coating would leave most of the gloss on the outside finish to facilitate cleansing and at the same time promote longer wear.

"A promising industrial use is as coatings for heating-furnace tools. These tools are repeatedly subjected to very high temperatures as they hold in place articles undergoing heat treatment."

Mr. Harrison said that the cost factor would not be controlling in determining whether to use the new coatings. Thinner coatings and other benefits, he said, would take care of the cost factor.

Quality Control Group Holding March Meeting

Chicago

• • • **Methods of controlling** industrial quality and performance will be featured at the Midwest Quality Control Conference to be held Mar. 5 and 6 at the LaSalle Hotel, Chicago.

W. E. Jones, conference chairman, points out that statistical quality control is probably the newest of management's industrial tools for adequate plant control. The conference, sponsored by the quality control societies of the Middle West in conjunction with the Chicago Assn. of Commerce, will be the first of its kind in this section of the country.

Feature speakers at this conference include G. D. Edwards, director of quality assurance for Bell Telephone Laboratories, New York, and M. H. Eisenhart, president of Bausch & Lomb Optical Co., Rochester, N. Y. Application of this technique to various industries will be demonstrated at 20 clinics. These will include a training program held by Professor L. A. Knowler of the State University of Iowa for those persons entirely unfamiliar with statistical quality control.

Speed-Up Assemblies Where Screws or Nuts are Used

There is one *sure* method of speeding up both ordinary and intricate assemblies that involve quantities of screws or nuts — use Millers Falls Electric Screw Drivers and Nut Runners. At the same time you will find that their speed and efficiency effect a worthwhile reduction in cost.

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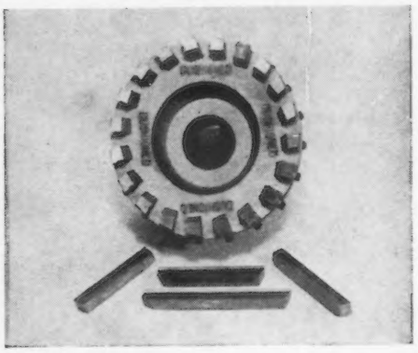

The outstanding performance attained with "CUSHIONED" 12% Cobalt High Speed Steel bits for general purpose tools naturally led to the application of this same "CUSHION" principle to Milling Cutter Blades.

Actual results with the "CUSHIONED" Milling Cutter Blades have been even more remarkable than in the case of the "Cushioned" H.S.S. Bits.

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And it will handle harder materials than has heretofore been possible. We have milled up to 600 Brinell with surprising speed.

Blades are from 66 to 69 Rockwell "C" hard.

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Workers Pension Plan Now Installed at All Wyckoff Steel Plants

Pittsburgh

• • • **Wyckoff Steel Co.**, according to an announcement by Joseph T. Somers, president, has adopted a retirement plan for its employees. The plan became effective Jan. 1, 1945, for all employees who have completed five years of service and who are under 70 years of age. It will apply to Wyckoff's plants in Ambridge, Pa., Chicago, Newark and Putnam, Conn.

The pension plan provides retirement income for the employees when they reach the normal retirement age of 65. Both future and past service of the employees are covered under the plan, with the retirement income benefits payable for life to the employees upon retirement.

Both the employees and the company will contribute toward payments of the premium, with the company paying the major cost of the plan. If an employee terminates service with the company before or after vesting begins, he can elect to receive the return of his own contributions to the plan plus 2 pct interest.

If the service of an employee is terminated after 15 yr of service, and he does not then or thereafter withdraw his own contributions, he will receive, commencing at normal retirement date, the retirement income purchased up to such date of termination by his own and the company's contribution.

Awarded Perkin Medal By Chemical Societies

New York

• • • **Dr. Francis C. Frary**, director of research, Aluminum Co. of America, was awarded the Perkin Medal for outstanding achievement in the field of industrial research at a dinner given at the Hotel Commodore recently by the Society of Chemical Industry, with the American Chemical Society, the American Institute of Chemical Engineers, the Electrochemical Society, and the Societe de Chimie Industrielle participating.

Some of the other recipients of

the Perkin Medal include: Dr. E. G. Acheson, who discovered artificial graphite and carborundum; Dr. Leo H. Baekeland, a pioneer in synthetic resins, such as bakelite; Dr. Irving Langmuir, whose name is associated with the gas filled tungsten lamp; Dr. Thomas Midgley, Jr., who gave us ethyl gas; and Dr. E. K. Bolton, under whose supervision neoprene and nylon were developed.

The chairman of the American Section of the Society of Chemical Industry, Francis J. Curtis, vice-president, Monsanto Chemical Co., presided at the dinner with James G. Vail, vice-president and director of research, Philadelphia Quartz Co., speaking on the personal side of the medalist, Dr. Frary, and Dr. Webster N. Jones, director of the College of Engineering, Carnegie Institute of Technology, discussing his technical accomplishments. Dr. Marston T. Bogert, Emeritus professor of chemistry, Columbia University, presented Dr. Frary with the medal.

AISI Proposes Changes In Wire Product List

Washington

• • • **Sponsored by a technical** committee of the American Iron & Steel Institute, the Bureau of Standards is developing two simplification programs. One proposes a list of stock sizes and types for wire nails and staples. It includes fence staples, poultry netting staples and all kinds of wire nails commonly used by the various building trades and box manufacturers.

The other proposes a revision of Simplified Practice Recommendation R9-28, woven wire fencing. It presents a list of stock items in the following products: farm fence, close mesh fence, wolf proof fence, poultry, chick fence, galvanized barbed wire and galvanized two-ply barbless wire.

Should these proposals as submitted, or as adjusted in accordance with suggestions which may be submitted, meet with the approval of producers, distributers and users, they will be promulgated and issued in printed form.

Copies available, Div. of Simplified Practice, National Bureau of Standards, Washington 25.

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The new Electro High-Speed Grinding Wheels offer faster cutting without troublesome heat development whether for snagging or precision operations, of which Electro's latest development is the resin-bonded Electro Cut-Off Wheel.

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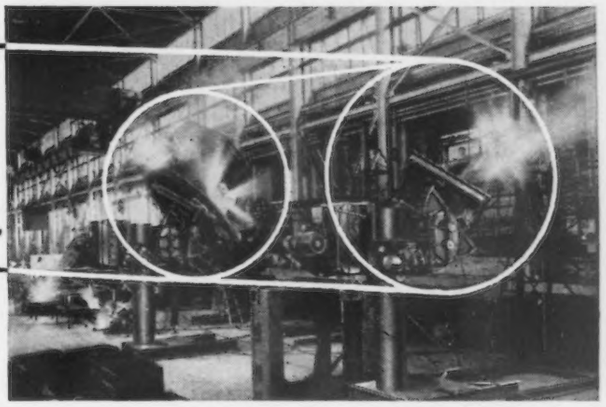

More welding and less time spent in flopping, propping up and crawling around weldments is the end result of the C-F Positioners in this welding department.

Mounted on C-F Welding Positioners, weldments can be quickly brought into position for a down-hand pass—better, more uniform welds with resulting economies and production increases follow. Weldors spend more time welding when they work with C-F Positioners because one "set-up" on the table allows them to maneuver the job without assistance, whether hand or power operated Positioners are used.

Power operated, variable speed C-F Positioners, with table rotation speeds in any range from 0 RPM and up, coupled with table tilt to 135° from the horizontal make them the logical choice for any production welding operation. Like all C-F Positioners, they have drilled tables for easy set-ups or tables can be quickly removed for installation of special fixtures or jigs. Write for Bulletin WP 22. CULLEN-FRIESTEDT CO., 1303 S. Kilbourn Ave., Chicago 23, Ill.

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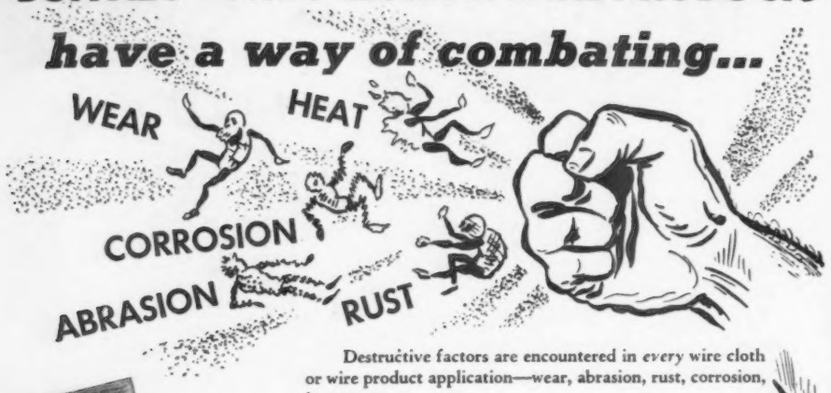

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Better Blast Furnace Practice Lowers Coke Consumption at Geneva

Washington

• • • **Coke consumption per ton** of iron produced at the Geneva plant has been considerably reduced as a result of recent improvements in blast furnace operation practices, according to the War Assets Corp.

Gross consumption of furnace coke per ton of iron produced through October 1945, averaged 2286 lb, WAC said, while consumption during November has averaged only 1654 lb, or a reduction of approximately 28 pct. This better operation is attributed to improvement in the coke brought about by a slight increase in oven temperature, a reduction in coking time and a better selection of coal for charging purposes.

Had Geneva achieved this degree of performance at the beginning of operations, the cost of hot metal would have been reduced approximately $3 per ton for a total saving of $2½ million, WAC said.

Blast furnace results during December were comparable with those of November, taking into consideration that November production was largely basic and low silicon merchant iron while a major portion of December production consisted of high silicon foundry grades. Preliminary results for December show 555 net tons of hot metal per day with net coke rate of 1822 lb per ton produced.

Present operations at the Geneva plant include one blast furnace, a battery of coke ovens, the power plant, coal mine and facilities at the iron mine and quarry.

Inventories at Geneva as of Jan. 12, 1946, it was disclosed, included the following: plates, 3268 tons; structurals, 1084 tons; slabs, 50,695 tons; pig iron, 35,914 tons; furnace coke, 9345 tons; coal, 13,568 tons.

Under a maintenance agreement dated Nov. 13, 1945, the Geneva Steel Co. (a subsidiary of United States Steel Corp.), agreed to maintain the plant in good state of repair and to service the plant during the period from Nov. 12, 1945, to July 12, 1946 and, incidental to such maintenance, to operate the above facilities to the extent provided in the agreement.

Mine Bureau Projects Long Term Program To Develop New Deposits

Washington

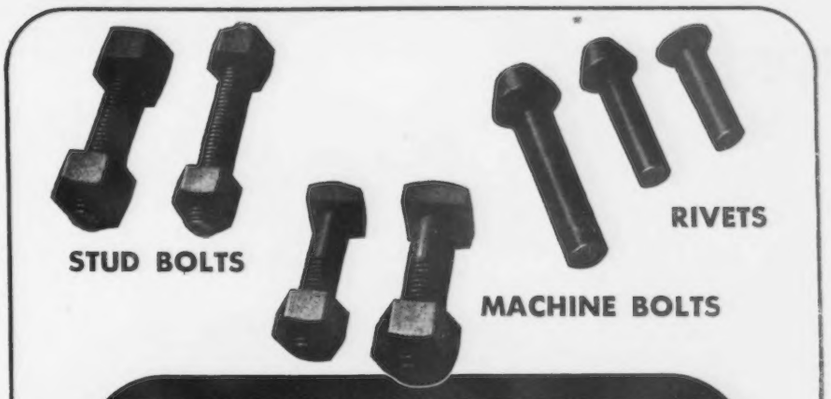
• • • **The inadequacy of known** reserves of many minerals emphasizes the need for advance preparation to strengthen the country's domestic supply for any future crisis according to the annual report of the Interior Dept.

Such preparation, Secretary of the Interior Harold L. Ickes said, should include some provision for national stockpiles of strategic and critical materials, together with an exhaustive mineral exploration and metallurgical research program. Surplus war materials, it was pointed out, would provide the nucleus for a stockpiling program and their storage would provide a means of preventing price deflation if they were dumped on the market.

The need for a comprehensive inventory of the nation's mineral resources is strongly emphasized. No accurate or even reasonably correct estimate of the location, extent, quality and minability of the various ores in the United States and Alaska now exists, the report said. The Bureau of Mines contemplates undertaking a long term program for the development and treatment of large strategic reserves which would be readily available should the need arise. The Bureau will also continue to render technical assistance to small mining operators engaged in extraction of low-grade and complex ores.

During the fiscal year 1945, Bureau of Mines engineers examined 850 mineral deposits and conducted exploratory projects on 150 deposits in 36 states and Alaska. Criteria followed by the Bureau in selecting deposits for exploration included (1) possibility that the project would make a substantial contribution to the national economy; (2) definite showing that such projects would produce materials for stockpiling purposes; and (3) the project must have been specifically directed by the Congress.

Continuing its search for additional iron ore reserves and ancillary materials needed for record steel production, the Bureau of



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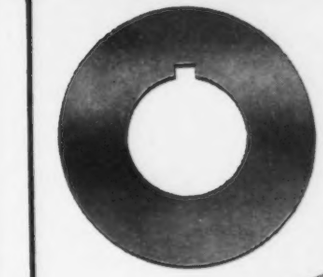

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Mines explored by drilling, trenching or tunneling 76 deposits in 27 states and Alaska. These included 32 iron, 16 fluorspar, 10 coal, six manganese, five tungsten, five nickel and two chromium deposits. In addition, the report stated, 450 deposits were examined by Bureau engineers.

Important reserves of iron ore aggregating many millions of tons were indicated in Arizona, Utah, Alaska, New Jersey, New York, Pennsylvania, Missouri and Virginia, the report said. Studies made in Alabama were said to indicate that sufficient tonnages of usable ore may be recovered from tailings of former operations.

Pilot-plant and cooperative investigations on manganese during 1945, according to the report, justify predictions that the United States will be considerably less dependent in the future on foreign sources for that strategic material. Electrolytic manganese produced at Boulder City, Nev., was said to have disclosed sufficient industrial applications to assure an adequate market for a plant of sufficient size to attain low production costs.

Development of Carryall mining and conical rolls separation for the Pierre manganiferrous shale near Chamberlain, S. D., the report said, promises a substantial reduction in production costs. According to the report, this development together with the successful electrolytic campaign on nodules at Boulder City, may eventually lead to the peacetime exploitation of the South Dakota deposit—the nation's largest manganese reserve—containing some 50 million tons of manganese in nodular form.

An electrolytic chromium pilot plant with a daily capacity of 100 lb was brought into operation at Boulder City, Nev., treating Montana chromites. Agglomeration tests on mixtures of off-grade chromite concentrates and Russian chromite fines, the report said, yielded a satisfactory feed material for ferrochromium furnaces.

Cobalt concentrates produced from low grade, complex, cobalt-copper-silver-gold ore, it was stated, were treated successfully in an electrolytic cobalt plant installed during the year at Boulder City.

Small-scale smelting tests on production of nickel-iron from iron-chromium-nickel ores were

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continued throughout the year at Salt Lake City and larger-scale tests are planned at the Northwest Laboratory, Albanny, Ore. Late in the year, laboratory tests on extraction of vanadium and phosphate from extensive deposits of Wyoming shale culminated with the installation and operation of a small pilot plant at Salt Lake City.

At Tuscaloosa, the report said, significant developments were made in hydraulic classification and flotation of Alabama iron ores. Sponge iron produced in saggers at Canton, Ohio, and Salisbury, N. C., and in rotary kilns at the Laramie, Wyo., and Johnstown, Pa., pilot plants of the Bureau of Mines were used successfully in melting tests at several commercial steel and wrought-iron plants.

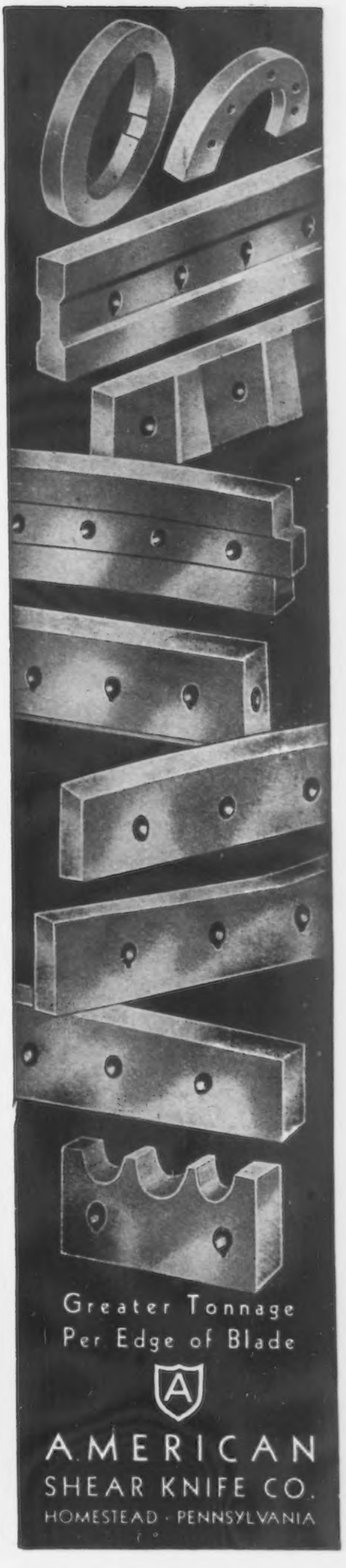
After magnetic separation tests at College Park, Md., disclosed that extremely high-grade concentrate could be made from magnetite ore occurring at Cranberry, N. C., the report said, a pilot plant was installed at the deposit to produce concentrates for the Salisbury sponge iron plants. The highest quality sponge iron ever made in substantial amounts was obtained from these concentrates, the report stated.

To increase supplies of critically needed acid-grade fluorspar, commercial milling of material stockpiled by the Metals Reserve Co. was made possible by pilot-plant and flotation tests on Spanish fluorspar and on similar Mexican and domestic material.

In the field of nonferrous metals —lead, zinc, copper, tin and various pegmatites—the Bureau of Mines simultaneously carried on a far-reaching exploratory program, a broad research and development plant, and a major drainage. Exploration of 28 lead and zinc deposits disclosed several large reserves. Bureau engineers examined 130 additional deposits during the year.

A major, low-grade copper deposit was confirmed in Pima County, Arizona, as the Bureau of Mines carried out 16 exploratory projects for copper in nine states. Another 85 deposits were examined by the Bureau.

A lode tin deposit on the Seward Peninsula of Alaska which was said to have greater potentialities than any other known domestic source of tin, was tested through



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diamond drilling by the Bureau of Mines. Another tin deposit was explored in California.

If Congressional approval is forthcoming, the Bureau of Mines proposes to establish 18 regions throughout the world and to assign technical specialists to the foreign service to aid in settlement of problems relating to supplies of mineral raw materials. Assistance is now being extended to Brazil under an authorization which may be used only in connection with those metals in which the United States is deficient.

War Assets Offers Plants

Washington

• • • **Following are government-owned industrial plants which the War Assets Corp. has announced are available for purchase or lease:**

Allegheny-Ludlum Steel Corp., alloy steel plant (18,000 tons capacity), Dunkirk, N. Y.

Anaconda Wire & Cable Co., wire plant, Sycamore, Ill.

Anaconda Wire & Cable Co., wire plant, Marion, Ind.

Gadsden Ordnance Plant, Gadsden, Ala., an Army forge and machine shop.

Shell casings plant operated by the J. B. Beaird Co., Inc., Shreveport, La.

Key Co. foundry, East St. Louis, Ill. Rated capacity of 450 tons of steel castings a month.

Wrentham Products Co., 2 plants, Wrentham, Mass. Machine tools were produced at one plant and bolts for aircraft engines at the other.

American Welding & Mfg. Co., plant, Warren, Ohio. Manufactured machine parts for tanks.

Allied Machine & Engineering Corp., plant, New Philadelphia, Ohio. Made ball and roller bearing lock nuts.

Unitcast Corp., steel foundry, Toledo, Ohio.

Lempco Products, Inc., plant near Cambridge, Ohio. Manufactured mortar shells.

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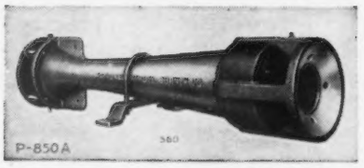

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Recessed facing of refractory insulating plastic protects end of nozzle which is exposed to furnace.

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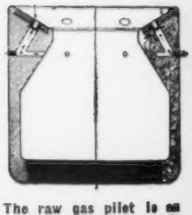

The raw gas pilot is an integral part of the nozzle in sizes 4" to 8" only. Not supplied on 2", 2½" and 3" nozzles.

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